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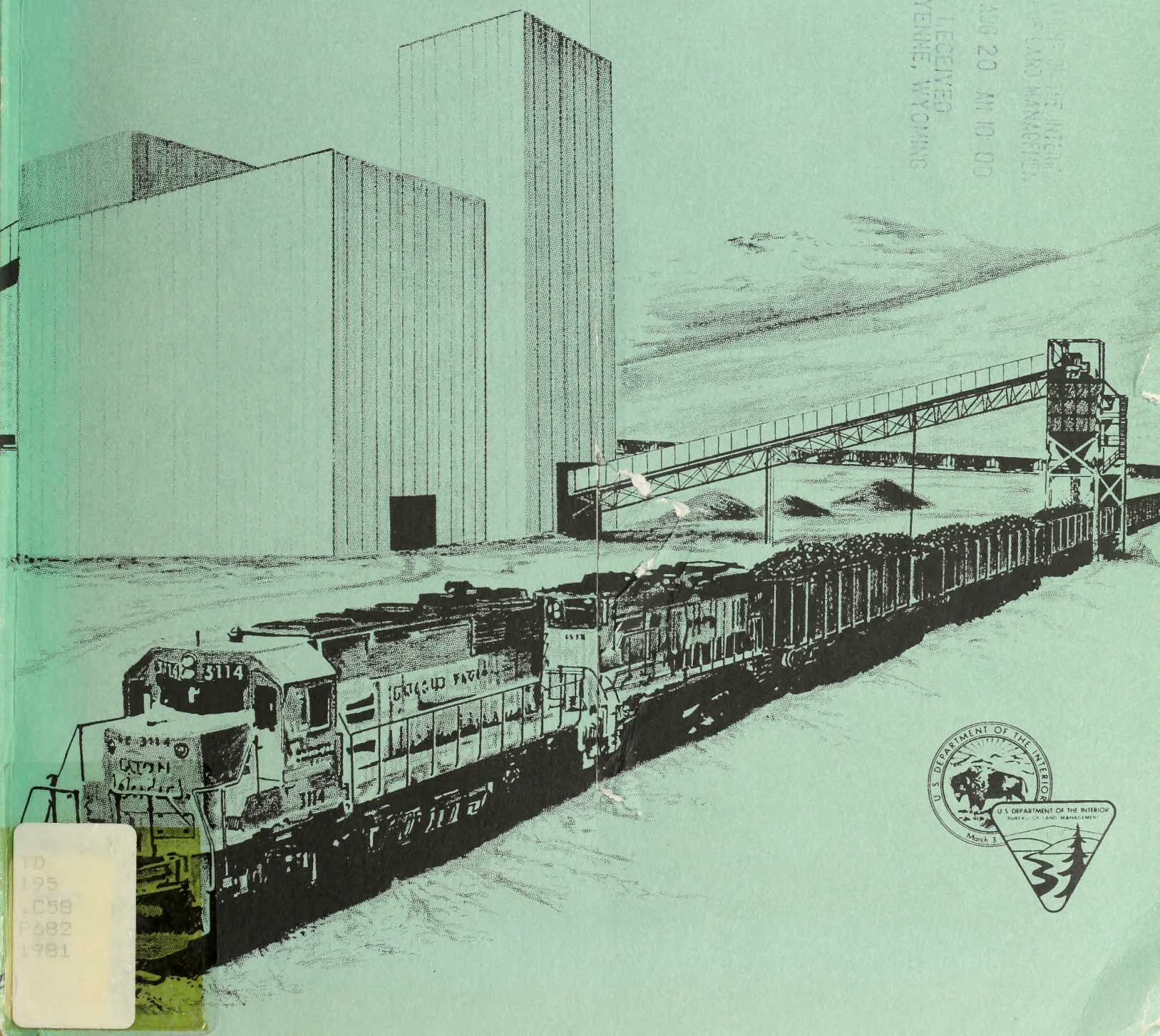

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POWDER RIVER COAL REGION
ENVIRONMENTAL IMPACT STATEMENT

(X) Draft ( ) Final

Lead Agency
U.S. Department of the Interior, Bureau of Land Management

Cooperating Agencies
U.S. Department of Agriculture
Forest Service

Type of Action

Administrative (X) Legislative ( )

Abstract

This statement assesses the environmental consequences of four alternative levels of coal development. The alternatives range from leasing 19 tracts (2.6 billion tons) to leasing 13 tracts (1.5 billion tons), and also includes the No-Action Alternative. The No-Action Alternative includes three I-90 coal exchanges, two noncompetitive leases, and 67 PRLAs totaling 15 mine units. The statement assesses impacts that would occur in Big Horn, Powder River, and Rosebud counties in Montana and Campbell, Converse, Crook, Johnson, Natrona, Sheridan, and Weston counties in Wyoming, as a result of coal leasing and development; and, cumulative impacts from the I-90 exchanges, noncompetitive leases, and PRLAs.

For further information regarding this statement or proposed alternative action contact:

Mr. Charles Wilkie
Team Leader
Bureau of Land Management
951 Rancho Road
Casper, WY 82601

Date by which comments on the statement must be received: September 8, 1981

IN REPLY REFER TO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

1792-PR-EIS

State Office
P. O. Box 1828
Cheyenne, Wyoming 82001

JUN 24 1981

NOTICE

Enclosed is the Draft Powder River Regional Coal Environmental Impact Statement. Your review and comments regarding this Draft Environmental Impact Statement (DEIS) are invited. Please direct your written comments to the EIS Team Leader, Bureau of Land Management, Casper District Office, 951 Rancho Road, Casper, Wyoming 82601. Written comments should be received by close of business on September 8, 1981.

Public hearings will be held in Montana and Wyoming according to the following schedule.

July 29, 1981
Crawford Room
Natrona Public Library
307 East Second
Casper Wyoming
1:30 p.m. and 7:30 p.m.

July 30, 1981
Ramada Inn
Mullowney Lane and I-90
Billings, Montana
1:30 p.m. and 7:30 p.m.

Written requests to testify should be submitted to the EIS Team Leader at the above address prior to the close of business on July 28, 1981. Testimony presented at the public hearings will be fully considered and evaluated in preparation of the Final Environmental Impact Statement (FEIS). Those comments that pertain to the adequacy of the impact assessment or present new data will be addressed in the FEIS.

Please retain your copy of the DEIS. Portions of this document will not be reprinted in response to comments if changes on that particular section are minor.

Sincerely yours,

J William Eikenberry

for Maxwell T. Lieurance
State Director

Enclosure

DISTRIBUTION LIST

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Powder River County Commissioners
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Sheridan County Commissioners
Weston County Commissioners

MAJOR SPECIAL INTEREST GROUPS

American Wilderness Alliance
Friends of the Earth
National Wildlife Federation
Northern Plains Resource Council
Powder River Basin Resource Council
Sierra Club
Wilderness Society

OTHER ORGANIZATIONS AND INDIVIDUALS

Numerous other organizations and individuals expressing interest in the proposed action have been sent copies of this statement and have been invited to comment.

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POWDER RIVER REGIONAL COAL ENVIRONMENTAL IMPACT STATEMENT

PREPARED BY:

BUREAU OF LAND MANAGEMENT

DEPARTMENT OF THE INTERIOR

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SUMMARY

This Environmental Impact Statement (EIS) is intended to be a part of the decision-making process, providing information to the Secretary of the Interior and the public concerning the use of coal resources from the Powder River Region. It has been prepared to comply with the Council on Environmental Quality (CEQ) regulations issued November 29, 1978 (43 FR 55978-56007), which emphasize concentration on significant issues and impacts. This emphasis sharply defines the options and provides a clear basis for choice by the decision-maker and the public.

Four alternative courses of action, ranging from no new federal leasing, to offering 19 delineated tracts for lease are addressed in this document. The issue of primary concern is the impact of coal mine development and population increases to communities. Many other resource impacts are presented and analyzed here; water resources, reclamation, air quality, sociology, economics, and railroad transportation are of primary significance. Many other resource impacts are presented, but in nearly every case, they are either insignificant or are mitigated by existing regulations. Differences in impacts are mainly by degree, rather than by type.

The alternative selected by the Regional Coal Team (RCT) as the preferred alternative would offer for lease in mid-1982 14 tracts which would result in an average annual production of about 50 million tons. Eight of the 14 tracts are considered production maintenance.

Other alternatives considered herein are:

Alternative 1 (No Action) would result leasing in response to industry applications under the provisions of the Department of the Interior's Coal Management Regulations and Preference Right Lease Applications (PRLAs). There are 67 PRLAs organized into 15 groups that would be evaluated and leased, provided all leasing criteria are met, by 1984. The analysis of this alternative shows that impacts expected from the current new mine development would be greater in magnitude than any one of the three federal leasing alternatives.

Alternative 2 considers leasing 1.5 billion tons of recoverable coal reserves from 13 tracts. The average annual production from this alternative would be about 46 million tons. An estimated surface disturbance of 57,400 acres would result from implementation of this alternative.

Alternative 3 analyzes impacts from the proposed leasing of 14 tracts including 1.5 billion tons of recoverable coal reserves. Average annual production from this alternative would be about 50 million tons. Surface disturbance would total 64,200 acres. This alternative offers the most favorable ratio of coal produced to environmental impacts generated, and is the preferred alternative.

Alternative 4 is the maximum alternative and considers leasing 2.6 billion tons of recoverable coal reserves from 19 tracts. Average annual production from this alternative would be about 90 million tons. Surface disturbance associated with this alternative would amount to 83,500 acres. This alternative would produce the most widespread environmental impacts of all federal action alternatives. Impacts would be most severe to the unicorporated community of Ashland, Montana, where population would increase eightfold by 1990.

GENERAL CONCLUSIONS

The No-Action Alternative would have impacts considerably greater than any of the other alternatives in this EIS. Most impacts, which can be traced to new federal leasing, gain their significance by magnifying impacts already identified. Therefore, impacts identified for all the alternatives differ by magnitude rather than type. Magnitude of impact is generally proportionate to the amount of coal produced.

Impacts in Wyoming center around the urbanized community of Gillette in Campbell County. Gillette has been experiencing energy-related impacts over the past ten years. Impacts in Montana would center around the rural, unincorporated community of Ashland in Rosebud County. Unlike Gillette, Ashland has experienced very little growth over the past decade. Therefore, social and economic impacts, caused by increased population, would heavily affect Ashland.

All the alternatives, including the No-Action, would further commit the region to a single economic base (coal). This trend is well established in Wyoming but would create a shift in economic base in Montana where agriculture has accounted for a significant part of the economic base to date.

HIGHLIGHTS

GEOLOGY AND OTHER MINERALS

Coal, oil and gas, and uranium in economic quantities exist within the region. Coal production would not generally interfere with extraction of other energy minerals due to land-use planning constraints that minimize resource development conflicts.

WATER RESOURCES

Impacts as a result of new federal leasing would be very small regionally. Loss of shallow local aquifers (the coal in many cases) is extensive and would reach 312,000 acres with the preferred alternative by 1990. Water from shallow aquifers is generally poor quality (3,000-5,000 mg/L DS) although water more suitable for human use is available and would be unaffected by the preferred alternative at the 1,000-1,600 foot level. Increased costs for greater pumping lifts and new well construction are associated with loss of shallow aquifers.

AIR QUALITY

Air pollution from mining and indirect development would be local and would not significantly affect air quality except in the vicinity of the coal lease tracts. Localized areas of impact would be near Colstrip and Decker, Montana, and throughout a 22-mile strip south of Gillette, Wyoming.

There are no significant impacts forecasted for the Ashland, Montana, area which adjoins the Class I air quality area on the Northern Cheyenne Indian Reservation.

SOILS, VEGETATION, AND RECLAMATION

Soils in the area are often shallow, although slopes are generally gradual on a rolling type terrain. Reclamation success has shown to be good (Packer, 1974), although some areas could require more intensive and costly management.

WILDLIFE

Leasing of all 19 tracts would have major affects on local populations of wildlife but minor affects on regional populations. Antelope would be affected heaviest south of Gillette, Wyoming, where existing mining facilities are restricting animal movement and disturbing habitat. Four hundred acres of crucial winter antelope habitat near Decker, Montana, would be lost. Populations of sharp-tailed and sage grouse would be impacted on a local basis.

CULTURAL RESOURCES

Federal and state regulations protect these resources. Historic and architectural resources on private lands may not be protected unless steps are taken by local governments and private citizens.

LAND USE

Lands within this region are administered and controlled by a variety of governmental jurisdiction, each of which exercises a different level of land-use planning, development, and resource-use control. Land ownership pattern is dominated (85 percent) by private surface ownership with federally controlled mineral estate (split-estate).

Land-use patterns are expected to shift from agriculture toward mining and urbanization without new federal coal leasing and implementation of the preferred alternative would change this very little. Forty-four ranch and farm operations would be affected. One operator would lose his total holdings and another would lose about 80 percent. All other operations would be affected to a lesser degree. Losses to the ranches that would be substantially affected would be offset by royalties or fees paid by the mines for the use of private land.

RECREATION

Funding for urban recreation facility construction and maintenance would be available. Dispersed recreational opportunities, such as camping and fishing, are restricted somewhat throughout the region and the quality of these experiences may be diminished even further because of the expected increase in population under Alternative 1 (No Action). New federal leasing would not appreciably affect dispersed recreation.

Most of the mining considered in this EIS would severely alter the landscape. These lands are not given a high visual resource classification and in most cases are seldom seen by persons not involved in mining. Thus, degradation of visual quality would not be obvious.

There are no areas of wilderness within the region. The wilderness areas that adjoin the region would be able to absorb the additional use anticipated by population growth.

TRANSPORTATION

Wyoming has adequate highway capacity to handle the increase in traffic volume. Required maintenance is expected to fall behind due to increased use by maximum-weight vehicles.

Montana's highway system is adequate in the Colstrip area but will require major upgrading in the Ashland/Decker areas. Highways of major concern include U.S. Highways 212 from Crow Agency to Ashland, and FAS 314 from Highway 212 to Decker.

Railroad traffic on the three main lines leaving the region would increase by 20 percent under the preferred alternative. This would equate to about 50 trains daily through Miles City, Montana, and about 100 each through Newcastle and Torrington, Wyoming.

SOCIOLOGY AND ECONOMICS

Increases in population are expected with or without new federal coal leasing. The fiscal impact to communities in Wyoming would not be significant. However, impacts to Montana communities, Ashland in particular, would be severe. Rosebud County would experience significant shortages of funds for county government and schools since the proposed mines are actually located across the county line in Powder River County. Most of these impacts could be mitigated but only through strong community commitment and assistance from both federal and state governments.

CHAPTER 1

PURPOSE AND NEED

INTRODUCTION

This chapter identifies the required authorizations, purpose and need for leasing within the region, review of program implementation within the region, other coal, issues and areas of concern identified through the environmental impact statement (EIS) scoping process, and tract ranking.

REQUIRED AUTHORIZATIONS

The development of federal coal resources is controlled by numerous laws and regulations imposed by federal and state authorities. Federal laws of foremost importance include the Federal Coal Leasing Amendments Act of 1976 (FCLAA), the Federal Land Policy and Management Act of 1976 (FLPMA) and the Surface Mining Control and Reclamation Act of 1977 (SMCRA).

The purpose of the FCLAA is to provide a more orderly procedure for the leasing and development of federally-owned coal than was set forth in its parent document, the Mineral Leasing Act of 1920.

FLPMA provides the BLM with a statutory framework for land-use planning on public lands and requires that BLM use the principles of multiple use and sustained yield, give priority to the protection of areas of critical environmental concern, consider present as well as future uses of public lands, and coordinate planning activities with those of federal and state agencies.

The SMCRA provides for state regulation of surface mining and reclamation on state and private lands as well as on federal lands under the terms of a cooperative agreement. Montana and Wyoming's programs for implementing the SMCRA have been approved by the Secretary of the Interior assuring that state regulations are as stringent or more stringent than federal regulation. In addition, cooperative agreements have been approved by both Montana and Wyoming, and the Department of the Interior. Thus, both states will have primary responsibility for assuring that standards are maintained for regulating surface mining and reclamation on federal, state, and private lands, and for assuring adequate protection from environmental impacts of surface mining. State regulations deal with such aspects as water and air pollution, land use, cultural and historic preservation, reclamation, wildlife and aquatic resources, and mine safety practices.

Each lease operator is required to submit a mining and reclamation plan that complies with Montana and Wyoming regulations and U.S. Geological Survey (USGS) rules (30 CFR 211) and which demonstrates that economic coal recovery is evaluated and that noncoal resources will be protected. Action on the mining and reclamation plan must be taken by the states and the Assistant Secretary for Energy and Minerals.

PURPOSE AND NEED FOR LEASING WITHIN THE REGION

In June 1979, the Secretary of the Interior adopted a new program for management of coal resources on federal lands. This program is fully described in the Final Environmental Impact Statement: Federal Coal Management Program, in the federal regulations (43 CFR 3400), and in Federal Coal Management Program-A Narrative Description. These documents are available from the Bureau of Land Management, Office of Coal Management, Department of the Interior, 18th and C Streets, N.W., Washington, D.C. 20240.

When the Secretary adopted this new coal program, he tentatively selected various leasing targets for the coal regions in terms of tons of federal coal reserves to be leased according to a selected schedule. The tonnages contained in these leasing targets were derived from Department of Energy (DOE) production goals.

Tract selection for the Powder River Region was conducted by the RCT at the January 21, 1981, meeting in Cheyenne, Wyoming. The Federal Coal Management Program calls for the selection of the EIS preferred alternative after the regional lease target level is named by the Secretary of the Interior. The RCT selects a grouping of specific tracts to meet the leasing level favored by the Secretary. This alternative then becomes the preferred alternative in the EIS. Other lease alternatives, above and below the preferred, are also selected by the RCT for EIS evaluation. Final lease decisions,

which tracts will be offered, are made by the Secretary after completion of the EIS.

In the case of the Powder River Region, the final DOE production goals were not available to the RCT at the time of selection. Therefore, a secretarial decision naming a preferred leasing level had not been made. In order to maintain the project schedule, the RCT elected to make a selection of EIS alternatives they considered reasonable, but delay the identification of the preferred alternative.

The RCT, based on the information contained in the Tract Profiles (available from Casper District Office) and their knowledge of the development area, selected tracts that would produce specific development levels (new mining operations) in the region. They also elected to include eight tracts expected to be used for the extention of existing mining operations. Specific information on each tract within the alternatives selected by the RCT is shown on Table 1-1. A discussion of each alternative is included in Chapter 2.

REVIEW OF PROGRAM IMPLEMENTATION WITHIN THE REGION

The programmatic EIS, cited above, analyzed potential effects of alternative coal management programs (BLM, 1979b). In that same year the Secretary of the Interior selected the present Federal Coal Management Program (Secretarial Issue Document). Coal management regulations were developed and are contained in Title 43, Code of Federal Regulations, Group 3400 (43 CFR 3400). As part of his decision, the Secretary scheduled competitive coal lease sales in the Powder River Region for 1982 and 1984, and established tentative leasing target of 776 million tons for 1982.

Areas considered suitable for further consideration for coal leasing in this EIS were made available through land-use planning. The BLM, Casper District Office, Wyoming, provided a supplement to the 1977 Eastern Powder River Basin Management Framework Plan (MFP) in 1979 (Highlight Review Area Supplement), and amended that same MFP in 1980 (Gillette Review Area Amendment).

Montana tracts being considered were made available through land-use planning carried out by the BLM, Miles City District Office, Montana. The 1979 Powder River Resource Area MFP Update Report updated the 1977 MFPs for the Rosebud, Coalwood, and Decker-Birney planning units.

There may be a number of anticipated leasing actions that would take place in the future, in lease sales scheduled for 1984. The Department has determined it appropriate to state the information it now has regarding the status of these anticipated actions. One anticipated action involves federal coal located in the Hanging Woman Creek area of the Decker-Birney management framework planning area in Montana. AMOCO Minerals Company entered into agreements with Kendrick Cattle Company in 1977 regarding fee coal and surface over federal coal in this area. The fee coal reserves are insufficient to support a long-term operation, and AMOCO and Kendrick (the only affected surface owner) have expressed a strong interest in having the federal coal in the area offered for a lease sale. Because of this interest, an MFP amendment was completed in 1979 applying the unsuitability criteria. The Northern Plains Resource Council (NPRC) protested the final MFP amendment and application of the unsuitability criteria. The Montana State Director denied the protest and NPRC appealed. Due to the delay caused by consideration of this protest, the Director removed the areas covered by the protest from activity planning, and requested a new MFP amendment be prepared which would include, among other things, the exchange areas included in the No-Action Alternative, several mine extension areas, and areas of high industry interest, including Hanging Woman Creek. Coal lands found acceptable for further consideration would be scheduled for the 1984 lease sale.

The NPRC in affiliation with Tongue River Agricultural Protection, Rosebud Protection, and Tri-County Ranchers' associations filed a petition under Section 522 of SMCRA (Tongue River Petition, December 1980) alleging that certain lands in Rosebud and Powder River counties in Montana were unsuitable for surface coal mining. A Petition Evaluation Document is being prepared by OSM. The draft is scheduled to be available in September with public hearings scheduled for late October 1981. A decision is expected in late December, and distribution of the final document is scheduled for January 1982.

In addition to the planning being carried out in the Decker-Birney, Coalwood, and Rosebud planning units in Montana, planning is also being carried out in the Western Powder River Basin (Sheridan and Johnson counties), and the Recluse Review Area (northern Campbell County) in Wyoming. The Forest Service is amending its land-use plan for Thunder Basin National Grasslands in Wyoming. Areas found acceptable for further consideration from these planning efforts, plus those delineated tracts not sold in 1982, would be available for the scheduled 1984 coal lease sale in the region.

OTHER COAL

Public Law 95-554 dated October 30, 1978 directs the Secretary of the Interior to consider specific coal leases along Interstate 90 in Wyoming for exchange. Seven lease holders are affected by this public law. One lease holder, Texaco, was granted an exchange in 1980. Three applicants (Carter-Exxon, Gulf Oil Company, and Wyodak) will be assessed in this EIS under the No-Action Alternative. Site- specific environmental assessments (EAs) will be prepared at a later date. The remaining three I-90 exchange applicants (Belco, Big Horn, and Kerr-McGee) will be analyzed later.

There are 67 preference right lease applications (PRLAs) in Wyoming. The cumulative impacts of these are assessed under the No-Action Alternative. Site-specific EAs will be prepared on these PRLAs in 1982.

Public Law 96-401 authorizes and directs the Secretary of the Interior to negotiate a cancellation agreement between the Northern Cheyenne Indian Tribe and parties holding leases or permits on Indian land. An agreement would provide for issuance of a noncompetitive lease for lands adjacent to existing operations and/or issuance of a certificate of a coal lease bidding right for an amount equal to the investment made by each party. The deadline for an agreement on leases was November 1, 1980, and permits must be agreed upon by January 1, 1982. Peabody Coal Company is the only lessee (six leases) affected by this public law; they also hold three permits. A settlement agreement was made between the Northern Cheyenne and Peabody on October 20, 1980, for a noncompetitive lease on lands in Rosebud County, Montana, called the Greenleaf-Miller project, which is included in the No-Action Alternative. Five parties hold the remaining eight permits. AMAX (holding three permits) is negotiating for lands adjacent to their Eagle Butte Mine or one of two areas adjacent to the Belle Ayr Mine, Campbell County, Wyoming. Consolidation Coal Company (CONSOL) (holding one permit) is seeking lands adjacent to its CX Ranch property, Big Horn County, Montana. Chevron Oil Company (holding one permit) is negotiating with CONSOL for a percentage of CX Ranch and will request lands adjacent to that lease. Negotiations have not begun with the remaining permit holders--Bruce L. Ennis, and Norsworthy and Roger, Inc.

There are substantial amounts of economic coal reserves on the Crow and Northern Cheyenne Indian reservations available for leasing at each tribe's discretion.

The anticipated production from Youngs Creek Mine owned by Shell Oil Company located in Big Horn County on the Crow Indian Reservation was inadvertently left out of the No-Action Alternative (baseline). An EIS has been prepared, and coal production is projected at 4.0 million tons in 1985.

Energy production within the region is at an all-time high and rapid growth is occurring. Oil and gas exploration is proceeding at record setting levels. Feasibility studies for additional coal-fired power plants are being conducted by companies such as Tri-State Electric and Black Hills Power and Light. Construction contracts are nearing completion for a second Wyodak power plant operated by Black Hills Power and Light. Uranium exploration and production has taken a down turn and the near-term market remains uncertain.

Feasibility or permitting studies are in progress on synthetic fuel production processes including synthetic gas production and liquefaction of gasoline from coal. Most notable of this group include WyCoalGas, Mobil's liquefaction process, the Hampshire syn-gas project, and ARCO's in situ gasification project.

Energy Transportation System Incorporated's (ETSI) coal slurry pipeline is scheduled for completion in 1984. Coal for the pipeline will be supplied by the Ft. Union and Jacob's Ranch mines, which are in production. There is no indication that coal from new federal coal leasing would be transported by the ETSI coal slurry pipeline.

ISSUES AND AREAS OF CONCERN

A notice of intent (NOI) to prepare this EIS appeared in the *Federal Register* on October 30, 1980. This NOI sought public participation in determining the scope and significant issues to be analyzed. The NOI also announced that public meetings would be held in the areas that would be directly affected.

News releases and cards announcing the public meetings were distributed. Public meetings were held the first week in December 1980 at Douglas, Gillette, and Sheridan, Wyoming; Ashland and Colstrip, Montana. Those attending were from industry, state, county and federal agencies, news media, and the general public. Letters requesting the public to participate were mailed prior to the meetings. Self-addressed, stamped comment cards and descriptions of the preliminary tracts were enclosed with the letters, and also handed out at the public meetings.

The majority of concerns expressed through the scoping process focused on impacts to water resources, air quality, socio-economics, and transportation. Concern was also expressed over the reclamation of the lands after mining. Several comments were made by the public stating the beneficial aspects of mining more coal, especially the increase in jobs. Property owners residing at Nickelson Little Farms, a subdivision northeast of the Rocky Butte tract, were concerned over the mining disturbances. A 1¼ mile buffer was established southwest of the subdivision by re-delineating the tract.

Records of the scoping process are available for review at the Casper District Office.

TRACT RANKING

The RCT used the information presented in the Tract Profiles (BLM, 1981) to develop the tract ranking factors in the general categories of coal, environmental, and socio-economic data. Ranking factors within these categories are presented in Table 1-2.

These factors were used by the RCT to rank the tracts into low, medium, and high categories of desirability for leasing. Table 1-3 presents the results of the ranking of the tracts.

A detailed discussion of the ranking and selection processes is contained in the minutes of the RCT meetings held in January and March, which are available at the BLM Wyoming State Office in Cheyenne.

TABLE 1-1
COAL DATA

Tracts	Coal Ownership (Acres) [a]					Reserves (Million Tons) [b]							
Maintenance Tracts	Federal Uncommitted	Federal Leased	State	Private	Total	Reserve Base (Million Tons) Federal Uncommitted	Federal Uncommitted	Federal Leased	State	Private	Total	Percent Recovery	Yearly Prod. (Million Tons)
Colstrip A&B [c]	1,632	2,240	280	3,613	7,765	65	36	59	2	56	153	90	7.8
Colstrip C [c]	853	1,586	640	3,604	6,683	22	19	48	14	85	166	90	5.5
Colstrip D [c]	2,300	0	0	2,811	5,111	48	43	0	0	54	97	90	3.4
Fortin Draw	320	0	0	0	320	50	45	0	0	0	45	90	5
Little Rawhide Creek	491	0	0	0	491	100	90	0	0	0	90	90	20
North Decker	2,050	1,850	0	0	3,900	77	69	67	0	0	136	90	3
Spring Creek	650	2,365	640	0	3,655	39	35	283	37	0	355	90	7
West Decker	40	3,040	640	0	3,720	6	5	143	36	0	184	90	6.1
Totals	8,336	11,081	2,200	10,028	31,645	407	342	600	89	195	1,226		57.8
New Production Tracts													
Ashland (Coslwood) [d]	3,129	0	400	3,326	6,855	265	239	0	11	168	418	90	10.4
Cook Mountain [e]	2,097	0	80	1,391	3,568	198	178	0	0	76	254	90	6.4
Coal Creek [e]	1,032	0	320	1,935	3,287	67	60	0	11	93	164	90	4.1
Ashland (Decker-Birney)	1,949	0	640	2,939	5,528	132	119	0	56	203	378	90	9.1
Duck Nest Creek	2,584	0	0	0	2,584	351	316	0	0	0	316	90	10.5
Northwest Otter Creek	1,311	0	640	3,484	5,435	154	139	0	62	210	411	90	10.3
Rocky Butte	5,060	0	640	200	5,900	494	445	0	16	4	465	90	15.5
Southwest Otter Creek	1,881	0	1,185	4,344	7,410	144	130	0	50	219	399	90	10
Spring Draw	4,093	0	717	40	4,850	451	383	0	42	3	428	85	14.3
Timber Creek	4,427	0	0	401	4,828	220	187	0	0	9	196	85	6.5
Kintz Creek	3,280	0	640	0	3,920	214	193	0	50	0	243	90	8.1
Keeline	3,077	0	640	0	3,717	194	175	0	28	0	203	90	6.8
Totals	30,791	0	5,502	14,734	51,027	2,619	2,325	0	315	817	3,457		101.6

[a] Acreage figures derived from master title plates.
[b] Tonnage figures received from USGS.
[c] Tonnage for the Rosebud Bed only.
[d] Tract not added into totals.
[e] Part of Ashland (Coalwood) tract.

TABLE 1-2
RANKING FACTORS

Coal Data	Environmental Data	Socio-economic Data
Economic Viability	Wildlife Habitat	Disruption of Family Farms/Ranches
Expansion of Existing Mines	Reclamation Potential	Changes to Agricultural Productivity
Land Pattern (Including State Lands)	Oil and Gas Development	Changes to Rural Quality of Life
	Air Quality	Changes to Communities & Local Services
	Cultural & Historic Values	Conflict With Other State/Local Development Plans

TABLE 1-3
TRACT RANKING

Tract	Ranking			
	Coal	Env	S/E	Overall
Wyoming:				
Little Rawhide*	H	H	H	H
Duck Nest Creek*	H	H	H	H
Fortin Draw*	H	H	H	H
Two Top	H	H-M	H	H-M
Rocky Butte*	H	M	M	H-M
Timber Creek*	H	M	H	H-M
Keeline*	H	M	M	M
Mt. Logan	H	M	M	M
Kintz Creek*	H	M	M	M
Wildcat	M	M	M	M
Calf Creek	M	M	M	M
Hay Creek	M	M	M	M
Spring Draw*	M	M	M	M
Rock Pile	M	L	M	L-M
Montana:				
Colstrip A&B*	H	M	M-H	H
Colstrip C*	M	M	M-H	H
Colstrip D*	M-H	M	M-H	H
Spring Creek*	H	M-H	H	H
North Decker*	M-H	M-H	M	H
West Decker*	H	H	M	H
Ashland (Coalwood)*	M-H	L-M	L	M
Ashland (Decker-Birney)*	M-H	L-M	L	M
Northwest Otter Creek*	H	L-M	L	M
Southwest Otter Creek*	M-H	L-M	L	M

H - High; M - Medium; L - Low
Env - Environmental
S/E - Socio-economic

* Tracts selected for the 1982 lease sale.

CHAPTER 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

INTRODUCTION

This chapter describes the environmental impacts of three leasing alternatives and no action based on information and analyses described in Chapter 4. Site-specific analysis of the tracts included may be found in the individual Tract Profiles (BLM, 1981). Location of the tracts and interrelated projects are identified on the Regional Activity Map. Alternatives as described, combined with the affected environment from Chapter 3, serves as the base for analysis in Chapter 4.

Two tracts, Spring Draw and Duck Nest Creek, have actions of note that apply to them. Carter-Exxon, through I-90 exchange procedures, applied for 560 acres and about 43 million tons of recoverable coal in the Spring Draw tract. Shell, which also has interest in the Spring Draw tract, asked that the acreage not be deleted from the tract until the decision whether or not to lease the tract competitively was made. The RCT granted Shell this request. AMAX is negotiating with the Department for a noncompetitive lease in the northern part of Duck Nest Creek, containing 135 million tons of coal, under the provisions stated in Public Law 96-401.

In the interest of presenting a clear comparison of alternatives, we have limited the resource disciplines to water, air quality, reclamation, railroad transportation, sociology, and economics in this chapter. These resource components were identified through the scoping process as of major interest to the public. Detailed analyses of impacts to all affected resources may be found in Chapter 4. Cumulative environmental impacts are summarized in Table 2-1.

The alternatives are directed toward leasing various combinations of tracts to make specific tonnages of coal available for production. For analytical purposes it is assumed in each alternative that all tracts offered will be leased and, further, that they will be mined in the time frame covered by this analysis. However, it is recognized that in reality coal production will generally be governed by market demand, unless artificially constrained or encouraged. Over-leasing is not expected to drive coal production past market demand but will provide industry with a selection of tracts from which to produce. This will both compensate for any uncertainties in the base and encourage competition. Thus, the impact analysis for Alternative 4 represents a worst-case situation. The relationship between the leasing alternatives and the DOE projections are shown in Figure 2-1.

ASSUMPTIONS

The following assumptions were made to facilitate analysis of the environmental impacts of mining and coal-related developments considered in this EIS.

1) All relevant state and federal laws and regulations pertaining to coal mining and related activities will be followed and enforced. The most important of these are: Office of Surface Mining (OSM) Reclamation and Enforcement regulations (30 CFR parts 700-899), Environmental Protection Agency (EPA) regulations (40 CFR parts 0-1399), Department of the Interior's Coal Management Program regulations (43 CFR parts 23 and 3400 and 30 CFR part 211), 36 CFR 800, Montana Department of State Lands, and Wyoming Department of Environmental Quality (DEQ) regulations.

2) Counties which would receive the majority of impacts would be Powder River and Rosebud in Montana, and Campbell in Wyoming. In Montana, 40 percent of the socio-economic impacts would occur in Powder River County and 60 percent in Rosebud County.

3) Existing and proposed mines, and mines resulting from noncompetitive leases and PRLAs would be in production by 1990.

4) The maintenance tracts included in Alternatives 2, 3, and 4 would add to the mine life of the adjacent, existing mines rather than increase annual production.

5) State and privately owned coal included or adjoining federal lease tracts would be developed simultaneously with federal coal.

6) Coal production figures are recoverable reserves based on an 85 to 90 percent recovery rate.

7) Coal produced will be strip-mined and transported from the region by railroad.

8) Active mine life would be 40 years in Montana and 30 years in Wyoming.

9) A 3-year period (1982-1985) for mine and reclamation plan development and approval would follow leasing. During this time further information on cultural resources would be collected, and a permit obtained for surface mining. Facilities construction would require 2 years (1986 and 1987); the resulting mine would be in full production by 1990.

10) Reclamation will proceed concurrently with mining operations.

11) Lands used for housing or public facilities will not be reclaimed.

12) Postmining land use would be the same as the premining use, except for the lands used for housing or public facilities.

ALTERNATIVE 1

No new federal leasing would occur under this alternative. Annual production from the region will be from the 1979 level of 81 million tons of annual production to an estimated 369 million tons in the target year of 1990. While the yearly production would increase 359 percent without new federal leasing, it still would not generate the annual production required to meet the anticipated 1990 shortfall of 40.6 million tons based on the DOE high production goal. Table 2-2 shows coal development for the region under this alternative.

WATER RESOURCES

Water use would be about 600,000 acre-feet per year by 1990. Major uses would be for irrigation, 420,000 (unchanged from 1980); power plants, 46,000; municiple use, 34,500; uranium mining and milling, 14,320; and coal mining 7,430 acre-feet per year. New water uses anticipated include 20,200 acre-feet per year for coal slurry and 8,000 acre-feet per year for a synfuel plant.

Ground Water

Approximately 275,000 acres of aquifers would be removed by existing and projected mining operations. Coal mining would remove about 95 percent of the affected acres.

Approximately 250 existing wells and 25 springs on the mine sites would be destroyed, but wells usually can be replaced by tapping deeper aquifers or with wells in spoil aquifers. Springs may eventually reappear, but would be in different locations.

Impacts of coal mining on ground water are restricted to an area within a few miles from the mine site. Water levels in wells near the mine would be lowered during mining but would return to near premining levels after the site is restored. Recharge would probably increase in many areas because the postmining slope of the land surface would be less steep and reclamation practices to retain moisture and prevent erosion would increase infiltration. Shale layers that may have caused springs and seeps would be destroyed; however, the increased infiltration may cause increased ground-water inflow to streams or the creation of new springs and seeps near the mine site.

Surface Water

The major sources of surface water would involve water originating outside the region; the power plants and synfuels operation would use water from the Yellowstone and North Platte rivers, respectively. The interception and use of water in mining operations and water consumption by the increased population would reduce the surface outflow from the region by about 4,500 acre-feet per year (0.5 percent) during mining. This reduction in surface outflow would be too small to measure, except possibly in the Belle Fourche River below Moorcroft, Wyoming, where flow might be reduced about 3.5 percent (Table 4-2). The flow of the Yellowstone River would be reduced about 0.3 percent; the North Platte River about 0.7 percent.

Although the quantity of water lost is less than 500 acre-feet, the loss of approximately 84 point-watering sources would be a deterrent to the use of the areas by wildlife and livestock until water sources are restored.

The dissolved-solids (DS) concentrations of streams may increase as a result of leaching from coal spoils and increased sewage effluent. The greatest potential increase in DS concentrations would range from 0.02 percent in Otter Creek to about 5 percent in the Belle Fourche River (Table 4-2). Increased DS concentrations resulting from increased sewage effluent would be about 0.07 percent in the Tongue and North Platte rivers by 1990. The increases in DS concentrations would be long-term but would have no significant impact on current uses of the water or on aquatic biology downstream. The DS concentrations of the Yellowstone and North Platte rivers would be increased about 0.1 percent or less.

AIR QUALITY

Regional changes in air quality would be insignificant as a result of coal exchanges, PRLAs, uranium mining, power plants, and population increases resulting from these activities. However, the impacts would be significant in the near vicinity of each mine (generally within 1 mile of the individual mine boundary). Estimates of total suspended particulates (TSP), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) emissions were calculated for mines, cities, major roadways, and major point sources. By 1995 in the impact areas, an estimated 69,300 tons of particulates would be generated annually by the existing coal mines.

SOILS, VEGETATION, AND RECLAMATION

The success of reclamation and revegetation would depend on the nature of the mine site and the specifics of the mine and reclamation plan. Reclamation success has shown to be good (Packer, 1974), although some areas could require more intensive and costly management. A total of 210,000 acres would be reclaimed.

TRANSPORTATION

Railroads

Appendix F (Figure F-3), and Table 4-6 show the trains per day (TPD) for this alternative. It should be noted that these are estimates based on potential production increases; actual number of trains would depend upon contracts and coal demand. Other factors that could affect the number of coal trains are the proposed coal slurry pipeline and the proposed Chicago Northwestern/Union Pacific Line from Crandall, Wyoming, to Lyman, Nebraska. These factors may also change coal destination and the route of the unit train. Capacity of the lines that would be affected is well above the existing TPD rates. The capacity could be increased by installation of additional sidings, tracks, centralized traffic control, and other systems (personal communication, Peter Briggs, Burlington Northern, 1981). Appendix F (Figure F-4) shows interruptions for at-grade crossings.

Proposed railroad lines and spurs would add approximately 340 miles of railroad lines, which would include the proposed Tongue River Railroad, the proposed Chicago and Northwestern/Union Pacific Line, the proposed WyCoalGas Electric Line, and estimated lengths of access railroad spurs to new mines and PRLAs. Only the proposed Chicago Northwestern/Union Pacific Line would have an affect on train traffic on Burlington Northern (BN) lines leaving the region.

Table 4-6 gives a breakdown of TDP and at-grade crossing effects for Miles City, Montana (Northern Route); Gillette and Newcastle, Wyoming (Central Route); and Torrington, Wyoming (Southern Route).

SOCIOLOGY

Community Services and Facilities

Rosebud would be the most affected county in Montana under this alternative requiring 9 additional law officers, 78 teachers, 1 physician, 2 dentists, and 13 hospital beds by 1990. Powder River County would require an additional 17 teachers. Even though there is no hospital in Powder River County, an additional 10 hospital beds would be required, for the county population, either in Forsyth or Miles City, Montana (see Table 4-8).

Additional requirements by 1990 for Campbell County would be 49 law officers, 290 teachers, 12 physicians, 4 dentists and 27 hospital beds. Natrona County additional requirements are 26 law officers, 6 teachers, 20 physicians, 8 dentists, and 58 hospital beds (see Table 4-8).

Housing

Counties requiring a significant level of additional housing without new federal leasing would be Big Horn: 1,333; Rosebud: 1,813; and Campbell: 1,800 (Table 4-9).

ECONOMICS

Table 2-3 summarizes the possible 1990 budget levels for the counties, schools and communities that would be impacted most heavily. It is assumed that the budgets that would exist without additional

leasing would be balanced, that is expenditures would equal revenues.

The unincorporated community of Ashland would receive the heaviest population impacts within the region. The population in Ashland is projected to be 800 in 1990 without additional leasing in the region.

ALTERNATIVE 2

Table 1-1 shows acres of coal ownership and reserves for the maintenance and new production tracts. Table 2-4 shows coal tracts and recoverable reserves by alternative.

This alternative proposes to lease 1.5 billion tons of recoverable coal reserves on 13 competitive lease tracts, eight of which would be used to extend the life of existing mining operations (production maintenance). Five new mining operations producing 46.2 million tons of annual production above baseline levels will result from leasing of this alternative. Based on mine life assumptions, this would support an annual production of about 421 million tons by 1990. Leasing at this level will satisfy the DOE annual production shortfall of 40.6 million tons.

Subalternatives apply entirely to the Ashland (Coalwood) tract or the two parts of this tract called Cook Mountain and Coal Creek. This format became necessary when the RCT requested delineation and a separate detailed analysis of the Cook Mountain and Coal Creek tracts in March 1981.

Assessment for Alternative 2 was based on worst-case, which is Subalternative 2C. However, impacts are not noticeably different between the subalternatives within any of the resource components, except economics (see Economics section).

SUBALTERNATIVE 2A

This subalternative considers leasing the maintenance tracts (Colstrip A&B, Colstrip C, Colstrip D, West Decker, North Decker, Spring Creek, Little Rawhide Creek, and Fortin Draw), Ashland (Coalwood), Northwest Otter Creek, Timber Creek, Duck Nest Creek, and Spring Draw. Maintenance tracts are adjacent to existing mines (Colstrip, Decker, Spring Creek, Eagle Butte, and Wyodak). These tracts contain smaller coal reserves than the competitive tracts and it is reasonable to assume that existing mines would acquire these leases. Coal production would reach 421 million tons annually within the region. Coal related employment would reach about 6,300 in Montana and 16,500 in Wyoming by 1990. Approximately 267,000 acres would be disturbed by mining within the region. The Ashland (Coalwood) tract would be considered for large or small business leasing. Timber Creek tract would be considered for small business development.

SUBALTERNATIVE 2B

This subalternative includes the maintenace tracts listed in Subalternative 2A, Coal Creek, Northwest Otter Creek, Timber Creek, Duck Nest Creek, and Spring Draw. Coal production would reach 415 million tons annually. Employment resulting from coal production would reach about 5,500 in Montana and 16,500 in Wyoming by 1990. Approximately 264,000 acres would be disturbed by mining within the region. The Coal Creek tract (the smaller part of Ashland (Coalwood)) would be considered for leasing to small business.

SUBALTERNATIVE 2C

In addition to the maintenance tracts described in Subalternative 2A this subalternative also includes Cook Mountain, Coal Creek, Northwest Otter Creek, Timber Creek, Duck Nest Creek, and Spring Draw. Coal production would reach 421 million tons annually. Coal related employment would reach about 5,800 in Montana and 16,500 in Wyoming by 1990. Approximately 267,000 acres would be disturbed by mining within the region. The Ashland (Coalwood) tract would be divided and leased as the Cook Mountain and Coal Creek tracts. Cook Mountain would be a large business lease and Coal Creek a small business lease.

WATER RESOURCES

Ground Water

Impacts on ground water resources under this alternative would add to those under Alternative 1; however, the increased coal production would cause little conflict with other uses of ground water.

Coal mining for this alternative would consume 925 acre-feet of water per year; however, most of this water would be supplied by rainfall on the mine

area and ground water seepage into the pit. Forty-seven wells would be destroyed, including 28 stock and wildlife wells, 12 domestic wells, and 7 wells not currently in use. About 58 wells near the tracts would be impacted to varying degrees but would not be destroyed. The destroyed wells could be replaced at approximately their original depth in the soil aquifer after reclamation, but the quality of the water would be poorer in most cases (3,000-5,000 mg/L average). Better quality water would be obtained at greater depths in most areas, but the static water levels in the deeper wells would be lower and pumping lifts would be greater.

Eight small springs would be destroyed thus reducing water available for stock and wildlife. These water supplies could be replaced by wells 200 to 300 feet deep equipped with windmills but would result in additional expense to install and maintain the wells and equipment.

Approximately 35,000 acres of shallow aquifer would be removed to depths of 100 to 400 feet and would eventually be replaced by spoil aquifers. The quality of the water in the spoil aquifers would be poorer (DS increase by a factor of 2 to 3) than the original aquifers but would be adequate for stock and wildlife (3,000-5,000 mg/L DS). The quality would be inadequate for domestic use, but better quality water is available at depths of 600 to 1,300 feet.

Population increase associated with this alternative would require 1,400 acre-feet of water. Most of the people would live in nearby towns and municipal water use would increase by about 4 percent. This increase would not have significant impact on the region as a whole, but could have considerable impact on Broadus, Ashland, and Gillette, since it is anticipated that these towns would have the largest increases in population.

Surface Water

Surface outflow from the region would be reduced by about 350 acre-feet per year (0.05 percent) during mining. The greatest effect would be in Otter Creek at Ashland, Montana, where flow might be reduced 1.3 percent (Table 4-2). Twenty point-watering sources would be destroyed but the quantity of water lost would be insignificant. However, the loss of point-watering sources would be a temporary deterrent to the use of the areas by wildlife and livestock.

The potential increase in DS concentrations in streams would range from 0.1 percent in Rosebud Creek to 4.0 percent in Armells Creek (Table 4-2). However, these increases would have no significant impact on current uses of the water or on aquatic biology downstream and no measurable affect on the salinity of the Yellowstone River.

AIR QUALITY

TSP levels would increase significantly on a localized basis. About 4,800 tons per year would be added to the Colstrip area, 2,200 tons per year to the Decker area, 2,900 tons per year to the Custer National Forest, and 5,500 tons per year to the Gillette area. Some potential exists for violations of National and State Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) standards near existing and proposed mines. Population and transportation emissions would cause increases of 70 percent above existing levels in the Custer National Forest and 5 percent in the Gillette area.

SOILS, VEGETATION, AND RECLAMATION

A total of 267,400 acres would need to be reclaimed which is 57,400 acres more than the baseline.

TRANSPORTATION

Railroads

Approximately 6 miles of new railroad spur would be needed. Appendix F (Figure F-3), and Table 4-6 show TPD and train interruptions for at-grade crossings.

SOCIOLOGY

Community Services and Facilities

Additional requirements to Rosebud and Powder River counties would be very similiar. These requirements are law officers: 2, 2; teachers: 27, 31; physicians 1, 0; dentists: 1, 1; and hospital beds: 4, 5; respectively (Table 4-8).

Campbell County would receive all major impacts in Wyoming with the additional requirements as follows: law officers: 5; teachers: 36; physician: 1; dentist: 1; and hospital beds: 3 (Table 4-8).

These additional requirements would be the same for Alternative 3.

Housing

Additional housing requirements in Powder River County would be 500; 280 of this amount would be located in the town of Broadus. Rosebud County would require 750 additional dwellings, which would all be located in the Ashland district. Campbell County would require 900 additional dwellings; 460 would be located in Gillette (see Table 4-9). These additional requirements would be the same for Alternative 3.

ECONOMICS

The fiscal impacts of Alternatives 2 and 3 would be the same. See Table 2-3. A negative balance in the table implies the potential of a budget deficit that would require tax levies or charges for services. The potential for budget deficits in Powder River and Rosebud counties would be least under Subalternative 2B or 3B.

Alternative 2 or 3 would add about 1,700 to Ashland's projected 1990 population of 800. Subalternative 2B or 3B would add about 1,200.

ALTERNATIVE 3

Under this alternative 1.5 billion tons of recoverable coal reserves would be leased on 14 competitive lease tracts, eight of which are considered production maintenance. Six new mining operations producing 50.3 million tons of annual production above baseline levels will result from leasing of this alternative. Based on mine life assumptions, this would support an annual production of 422 million tons by 1990. Leasing at this level will satisfy the DOE annual production shortfall of 40.6 million tons.

Subalternatives apply entirely to the Ashland (Coalwood) tract or the two parts of this tract called Cook Mountain and Coal Creek. This format became necessary when the RCT requested delineation and a separate detailed analysis of the Cook Mountain and Coal Creek tracts in March 1981.

Assessment for Alternative 3 was based on worst-case, which is Subalternative 3C. However, impacts are not noticeably different between the subalternatives within any of the resource components, except economics (see Economics section).

Subalternative 3B has been selected as the RCT's preferred alternative.

SUBALTERNATIVE 3A

This subalternative considers leasing the maintenance tracts described under Subalternative 2A, Ashland (Coalwood), Northwest Otter Creek, Timber Creek, Duck Nest Creek, Kintz Creek, and Keeline tracts. Coal production would reach about 422 million tons under this subalternative. Employment associated with coal activities would be about 6,300 in Montana and 16,500 in Wyoming. Acreage disturbed would be about 274,000 acres regionally. This subalternative is the same as 2A in Montana but substitutes Kintz Creek and Keeline tracts for Spring Draw in Wyoming. Kintz Creek would be leased for large business development and Keeline would be a small business lease.

SUBALTERNATIVE 3B

This subalternative includes the maintenance tracts described in Subalternative 2A, Coal Creek, Northwest Otter Creek, Timber Creek, Duck Nest Creek, Kintz Creek, and Keeline tracts. Coal production would reach about 415 million tons annually with this subalternative. Employment would be the same as Subalternative 2B. Acreage disturbed would be about 271,000 acres regionally.

SUBALTERNATIVE 3C

This subalternative includes the maintenance tracts described in Subalternative 2A, Cook Mountain, Coal Creek, Northwest Otter Creek, Timber Creek, Duck Nest Creek, Kintz Creek, and Keeline tracts. Coal production would reach about 422 million tons under this subalternative. Employment would be the same as Subalternative 2C for both states. Acreage disturbed would be about 274,000 acres regionally.

WATER RESOURCES

Ground Water

Annual water use for coal mining would be about 880 acre-feet and municipal use about 1,400 acre-feet. About 49 wells would be destroyed, including 34 stock and wildlife wells, eight domestic wells and nine wells not currently in use. About 60 wells would be impacted to varying degrees but would not be destroyed.

Approximately 37,000 acres of shallow aquifers would be removed to depths of 100 to 400 feet but would eventually be replaced by spoil aquifers.

Surface Water

Impacts to surface water under this alternative are the same as those described under Alternative 2.

AIR QUALITY

TSP levels would increase significantly on a localized basis. About 4,800 tons per year would be added to the Colstrip area, 2,200 tons per year to the Decker area, 2,500 tons per year to the Custer National Forest area, and 6,900 tons per year to the Gillette area. Some potential exists for violations of NAAQS and PSD standards near existing and proposed mines. Population and transportation emissions would cause increases of 70 percent above existing levels in the Custer National Forest and 5 percent in the Gillette area.

SOILS, VEGETATION, AND RECLAMATION

A total of 274,200 acres would need to be reclaimed which is 64,200 acres more than the baseline.

TRANSPORTATION

Railroads

Impacts to the railroads would be the same as Alternative 2 except for TPD and at-grade crossing effects for Torrington, Wyoming (see Table 4-6).

SOCIOLOGY

Impacts to community services and facilities, and housing are the same as described in Alternative 2.

ECONOMICS

The fiscal impacts of Alternatives 2 and 3 would be the same, as well as the increases to Ashland's population. See Table 2-3 and the Economics section under Alternative 2.

ALTERNATIVE 4

This alternative includes the maintenance tracts described in Subalternative 2A, Cook Mountain, Coal Creek, Ashland (Decker-Birney), Northwest Otter Creek, Southwest Otter Creek, Rocky Butte, Kintz Creek, Keeline, Timber Creek, Duck Nest Creek, and Spring Draw.

This is the maximum leasing alternative being evaluated in the EIS. Under this alternative 2.6 billion tons of federal recoverable coal reserves would be leased on 19 competitive lease tracts, eight of which are considered production maintenance. Eleven new mining operations producing 89.9 million tons annually above baseline levels will result from leasing of this alternative. Based on mine life assumptions, this would support an annual production of about 470 million tons by 1990. Leasing at this level will double the DOE annual production shortfall of 40.6 million tons. Employment associated with coal production would reach about 9,100 in Montana and 20,500 in Wyoming. Acres disturbed by mining would be approximately 293,000 acres regionally.

As indicated earlier, the following impact analyses assume that all coal offered will be leased and mined on schedule. However, it should be noted

that possible production under this alternative (467 million tons per year) exceeds DOE's 1990 high production goal (412 million tons per year). Production approximating DOE's high goal would result in impacts similar in type and severity to those described under Alternatives 2 and 3 rather than those presented below.

WATER RESOURCES

Ground Water

Increased coal production at this level would have more impact on the ground water resources than any of the other new leasing alternatives, but the regional impact would still be small and would cause little conflict with other uses of ground water.

Coal mining for this alternative would consume 1,920 acre-feet of water per year. However, most of the water would be supplied by rainfall on the mine area and ground water seepage into the pit. One hundred wells would be destroyed, including 60 stock and wildlife wells, 16 domestic wells, one industrial well (oil flooding), and 23 wells not currently in use. An additional 81 wells would be impacted to varying degrees but would not be destroyed. The destroyed wells could be replaced at approximately their original depth in the spoil aquifer after reclamation, but the quality of the water would be poorer (DS increase by a factor of 2 to 3). In most of the area better quality water (1,000 to 3,000 mg/L dissolved solids) can be obtained at greater depths but the static water level in the deeper wells would be lower and pumping lifts would be greater (BLM, 1979a).

Ten small springs would be destroyed and would not be re-established after reclamation, thus reducing water available for stock and wildlife. These water supplies could be replaced by wells 200 to 300 feet deep equipped with windmills; however, there would be expense to install and maintain wells and equipment.

Approximately 60,000 acres of shallow aquifer would be removed to depths of 100 to 400 feet and would eventually be replaced by spoil aquifers. The quality of the water in the spoil aquifers would be poorer (3,000 to 5,000 mg/L dissolved solids) but adequate for stock and wildlife. The quality would be inadequate for domestic use, but better quality water (1,000 to 3,000 mg/L dissolved solids) usually is available at depths of 400 to 1,300 feet.

The increase in population would require 2,700 acre-feet of water. Most of the persons would live in nearby towns and their water demands would increase municipal use about 8 percent. This amount would not have significant impact on the region as a whole, but could have significant impact on Ashland, Broadus, and Gillette since it is anticipated these towns would have the largest increase in population.

Surface Water

Surface outflow from the region would be reduced by about 700 acre-feet per year (0.1 percent) during mining. The greatest effect would be in Otter Creek at Ashland, Montana, where flow would be reduced 2.7 percent (Table 4-2). About 33 point-watering sources would be destroyed but the quantity of water lost would be insignificant. However, the loss of point-watering sources would be a temporary deterrent to the use of the areas by wildlife and livestock.

The potential increase in DS concentrations in streams would range from 0.1 percent in Rosebud Creek to 4.0 percent in Armells Creek (Table 4-2). However, these increases would have no significant impact on current uses of the water or on aquatic biology downstream and no measurable effect on the salinity of the Yellowstone River.

AIR QUALITY

TSP levels would increase significantly on a localized basis. About 4,800 tons per year would be added to the Colstrip area, 2,200 tons per year to the Decker area, 6,500 tons per year to the Custer National Forest area, and 11,900 tons per year to the Gillette area. Some potential exists for violations of NAAQS and PSD standards near existing and proposed mines. Population and transportation emissions would cause increases of 139 percent in the Custer National Forest area and 5 percent in the Gillette area.

SOILS, VEGETATION, AND RECLAMATION

A total of 293,500 acres would need to be reclaimed which is 83,500 acres more than the baseline.

TRANSPORTATION

Railroads

Railroad spurs needed to serve mine facilities would add approximately 30 miles of new railroad lines. Appendix F (Figures F-3 and F-4), and Table 4-6 show TPD and at-grade crossing effects.

SOCIOLOGY

Community Services and Facilities

Rosebud and Powder River counties would require the following additional services and facilities: law officers: 5, 3; teachers: 55, 60; physicians 1, 1; dentists: 1, 1; and hospital beds: 9, 9; respectively.

Additional services and facilities required for Campbell County are law officers: 10; teachers: 72; physicians: 3; dentists: 1; and hospital beds: 6 (Table 4-8).

Housing

Powder River County would require 1,000 additional dwellings; 800 of these dwellings would be located in Broadus. Rosebud County would require 1,500 additional dwellings all of which are located in the Ashland district. Campbell County would require 1,800 additional dwellings; 900 would be located in Gillette (Table 4-9).

ECONOMICS

The potential for budget deficits is the greatest under Alternative 4 (see Table 2-3). This alternative would add about 3,400 to Ashland's projected 1990 population of 800.

Agricultural Impacts

The impacts to agricultural economics under Alternatives 2, 3, and 4 are considered insignificant (Appendix G). Impacts to agricultural operations are discussed in the Tract Profiles (BLM, 1981).

CONCLUSION - PREFERRED ALTERNATIVE

Subalternative 3B is the preferred alternative. This meets the target level of leasing as chosen by the Assistant Secretary Land and Water Resource U.S. Department of Interior, which was set at 1.5 billion tons of recoverable coal. This decision is, however, an interim one in the process of determining how much coal will ultimately be offered for sale in the region. The final decision on the tracts which will be offered will be made after review of the final EIS and and public comments received on the draft.

TABLE 2-1
CUMULATIVE ENVIRONMENTAL IMPACTS

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Water Resources				
Ground Water Number of wells destroyed or impacted (maximum through mine life)	252 wells would be destroyed, 203 wells would be impacted.	299 wells would be destroyed, 261 wells would be impacted.	310 wells would be destroyed, 263 wells would be impacted.	352 wells would be destroyed, 284 wells would be impacted.
Acres of aquifers removed (maximum)	275,000	310,000	312,000	335,000
Number of springs destroyed	25	33	35	35
Water required for coal mining (acre-feet) in 1990	7,430	8,355	8,310	9,350
Municipal water required by population (acre-feet) in 1990 * Water used by incorporated communities and light industry.	32,000 *	33,400	33,400	34,700
Domestic water required (acre-feet) in 1990 ** Water used by rural subdivisions, rural residents and livestock.	23,000 **	---	---	---
Surface water Reduction in surface outflow (maximum percent) through mine life)				
Yellowstone River	0.3	.303	.303	.306
North Platte River	0.7	0	0	0
Increase in dissolved-solids concentration (percent)				
Yellowstone River	.09	.12	.12	.13
North Platte River	0.07	0	0	0
Loss of point-watering source (maximum through mine life)	84 point-watering sources would be destroyed	104 point-watering sources would be destroyed.	104 point-watering sources would be destroyed.	117 point-watering sources would be destroyed.
Air Quality				
Total TSP level (tons per year) (maximum production)	69,300	84,700	86,100	94,900

Table 2-1 continued

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Soils, Vegetation & Reclamation				
Total acres to be reclaimed	210,000	267,400	274,200	293,500
Transportation				
Total unit coal trains per day	183	234	242	262
Average interruption at at-grade crossing per day at 5 miles per hour	12 hours 10 minutes	15 hours 10 minutes	16 hours 5 minutes	17 hours 30 minutes
Probability of car-train accidents at an at-grade crossing for 1,000 motor vehicle per day	10 in 100 years	12 in 100 years	12 in 100 years	13 in 100 years
Sociology				
Community service requirements in 1990				
Powder River County				
Law Enforcement	4	6	6	7
Teachers	65	96	96	125
Physicians	1	1	1	2
Dentists	1	2	2	2
Hospital Beds	10	15	15	19
Rosebud County				
Law Enforcement	21	23	23	26
Teachers	221	248	248	276
Physicians	4	5	5	5
Dentists	6	7	7	7
Hospital Beds	39	43	43	48
Campbell County				
Law Enforcement	105	110	110	115
Teachers	707	743	743	779
Physicians	32	33	33	35
Dentists	9	10	10	10
Hospital Beds	58	61	61	64
Housing requirements in 1990				
Powder River County	1,150	1,650	1,650	2,150
Broadus	350	630	630	1,150
Rosebud County	5,600	6,350	6,350	7,100
Ashland District	350	1,100	1,100	1,850
Campbell County	17,600	18,500	18,500	19,400
Gillette	9,000	9,460	9,460	9,900

Table 2-1 concluded

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Economics				
Projected incremental net fiscal balances expected to result for local governments ($1,000)				
Powder River County, Montana	0	300	300	-900
County Schools	0	3,200	3,200	3,900
Broadus	0	100	100	-100
Rosebud County, Montana	0	-1,100	-1,100	-2,300
County Schools	0	-1,100	-1,000	-2,100
Forsyth	0	0	0	0
Ashland Population	800	2,480	2,480	4,200
Campbell County, Wyoming	0	4,300	4,300	8,600
School District #1	0	6,700	6,700	13,400
Gillette	0	-500	-500	-1,000
Net Energy Analysis				
Energy Produced / Energy Consumed (BTUs Annually)	---	223.0 / 1	225.8 / 1	221.6 / 1

TABLE 2-2
COAL DEVELOPMENT - POWDER RIVER REGION

Location and Name	Annual Production (Million Tons) a/ 1979	1985	1990	1995
Existing Mines				
Wyoming:				
Campbell County				
Belle Ayr (AMAX)	15.0	19.0	19.0	19.0
Black Thunder (Thunder Basin Coal Co.)	6.2	20.0	20.0	20.0
Caballo (Carter-Exxon)	1.3	7.5	12.0	12.0
Clovis Point (Kerr-McGee)	.3	4.0	4.0	4.0
Cordero (Cordero Mining-Sunedco)	3.8	15.0	15.0	24.0
Eagle Butte (AMAX)	3.7	19.0	20.0	--
Ft. Union (Ft. Union Mine Partnership)	.01	1.2	1.2	--
Jacobs Ranch (Kerr-McGee)	4.7	14.0	14.0	14.0
North Rawhide (Carter-Exxon)	3.6	24.0	24.0	24.0
Wyodak (Black Hills Power & Light)	2.4	5.0	5.0	5.0
Sheridan County				
Big Horn (Peter Kiewit & Sons)	3.5	4.5	4.5	4.5
Converse County				
Dave Johnston (NERCO)	3.8	3.2	3.2	3.2
Totals	48.31	136.4	141.9	129.7
Montana:				
Powder River County				
Coal Creek	.03	.03	.03	.03
Rosebud County				
Big Sky (Peabody)	2.5	4.2	4.2	4.2
Colstrip (Western Energy)	11.4	18.6	19.1	19.1
Big Horn County				
Decker-East and West	13.2	11.8	12.2	12.2
Absaloka (Westmoreland)	5.3	10.0	10.0	10.0
Spring Creek (NERCO)	--	7.0	7.0	7.0
Totals	32.43	51.63	52.53	52.53

TABLE 2-2 continued

Location and Name	Annual Production (Million Tons) 1979	1985	1990	1995
New Mines				
Wyoming:				
Campbell County				
Buckskin (Shell Oil Co.)	--	6.2	1.5	--
Coal Creek (ARCO Coal Co.)	--	8.5	10.0	10.0
Dry Fork (Cities Services Co.)	--	2.0	8.0	15.0
East Gillette (Kerr-McGee)	--	11.0	11.0	11.0
North Rochelle (Shell Oil Co.)	--	8.0	8.0	8.0
Pronghorn (Mobil Oil Co.)	--	5.0	5.0	5.0
Rochelle (Rochelle Coal Co.)	--	5.0	11.0	11.0
Caballos Rojo (Mobil Oil Co.)	--	9.0	15.0	15.0
South Rawhide (Carter-Exxon)	--	4.0	7.0	7.0
Wildcat Creek (Gulf Oil Co.)	--	5.2	10.0	10.0
Wymo Fuels Mine (Wymo Fuels, Inc.)	--	4.4	4.4	4.4
Sheridan County				
Ash Creek (Public Service of Oklahoma)	--	.5	.5	.5
Black Mountain (Black Mountain Coal)	--	.5	.5	--
Dutchman (JMT Co.)	--	2.0	2.0	2.0
Converse County				
Antelope (NERCO)	--	8.0	10.0	12.0
Totals	--	79.3	103.9	110.9

TABLE 2-2 continued

Location and Name	Annual Production (Million Tons) 1979	1985	1990	1995
New Mines b/				
Montana:				
Rosebud County				
CX Ranch (Peter Kiewit)	--	2.0	4.0	4.0
Montco-Nance (Montco)	--	2.0	9.0	12.0
Totals		4.0	13.0	16.0
PRLAs				
Wyoming:				
Campbell County				
Bell Fourche (Wold Nuclear Co.)	--	--	c/	--
East Black Thunder (Arco)	--	--	--	--
North Antelope (Peabody)	--	--	1.6	2.3
Rochelle Area (Peabody)	--	--	d/	d/
South Gillette (Peabody)	--	--	2.0	3.2
Thunderbird Project (El Paso Energy Co.)	--	--	3.5	5.0
Thunderbird II (Wold & Jenkins)	--	--	5.2	32.0
Wildcat Creek Area (CONSOL)	--	--	4.5	24.0
Sheridan County				
Ulm Project (Woodson Oil Properties)	--	--	14.0	14.0
Converse County				
Dull Center (Peabody)	--	--	1.7	1.7
Sand Draw (Peabody)	--	--	5.0	5.0
South Antelope (Peabody)	--	--	3.6	3.6
South Powder River (Dixie Natural Res.)	--	--	2.2	2.2
Stevens North (Western Fuels)	--	--	.8	3.0
Stevens South (Western Fuels)	--	--	1.5	1.5
Totals	--	--	45.6	97.5

TABLE 2-2 concluded

Location and Name	Annual Production (Million Tons) 1979	1985	1990	1995
Exchanges e/				
Wyoming:				
I-90				
Carter-Exxon (North Rawhide & Caballo)				
Gulf (Wildcat Creek)				
Wyodak (Wyodak Mine)				
Noncompetitive Leases (Northern Cheyenne)				
CX Ranch (CONSOL)	--	5.0	8.0	8.0
Greenleaf-Miller (Peabody)	--	--	4.0	6.0
Totals	--	5.0	12.0	14.0

a/ Final figures for 1980 production unavailable for inclusion into the draft.
b/ Youngs Creek Mine (Shell) located in Big Horn County not included (see Chapter 1).
c/ These exchanges are mine extensions and do not add to annual production.
d/ Mine life of 2 years projected for 1988 and 1989.
e/ To be mined in conjunction with the Rochelle Mine for gasification at Panhandle Eastern.

TABLE 2-3
PROJECTED 1990 BUDGET LEVELS, BY ALTERNATIVE, FOR THE COUNTIES, SCHOOLS, AND COMMUNITIES THAT WOULD BE IMPACTED MOST HEAVILY BY FEDERAL COAL LEASING IN THE POWDER RIVER REGION
(Rounded to the nearest $100,000; Includes Debt Servicing)

	Alternatives			
	1 a/	2 b/	3 b/	4 b/
	($1,000)	($1,000)	($1,000)	($1,000)
Powder River County				
Revenues	3,800	5,200	5,200	6,300
Expenditures	3,800	5,500	5,500	7,200
Balance	0	-300	-300	-900
Powder River County Schools				
Revenues	2,000	6,100	6,100	7,600
Expenditures	2,000	2,900	2,900	3,700
Balance	0	3,200	3,200	3,900
Broadus				
Revenues	200	400	400	500
Expenditures	200	300	300	600
Balance	0	100	100	-100
Rosebud County				
Revenues	9,800	9,800	9,800	9,800
Expenditures	9,800	10,900	10,900	12,100
Balance	0	-1,100	-1,100	-2,300
Rosebud County Schools				
Revenues	9,100	9,100	9,100	9,100
Expenditures	9,100	10,100	10,100	11,200
Balance	0	-1,000	-1,000	-2,100
Ashland c/				
Revenues	--	--	--	--
Expenditures	--	--	--	--
Balance	--	--	--	--
Campbell County				
Revenues	26,600	32,300	32,300	37,900
Expenditures	26,600	28,000	28,000	29,300
Balance	0	4,300	4,300	8,600
School District #1				
Revenues	69,800	80,100	80,100	90,200
Expenditures	69,800	73,400	73,400	76,800
Balance	0	6,700	6,700	13,400

Table 2-3 concluded

	Alternatives			
	1 a/	2 b/	3 b/	4 b/
	($1,000)	($1,000)	($1,000)	($1,000)
Gillette				
Revenues	19,800	20,300	20,300	20,800
Expenditures	19,800	20,800	20,800	21,800
Balance	0	-500	-500	-1,000

a/ These are the baseline budget levels that are expected to exist without additional Federal Competitive Leasing. Expenditures were projected from actual FY 1979/1980 budgets (including debt servicing) on a per capita basis in order to maintain the per capita spending levels of FY 1979/1980. It is assumed that revenues will equal expenditures.

b/ The additional expenditures above baseline expenditures, which are required to maintain FY 1979/1980 per capita spending levels for additional populations, were projected from actual FY 1979/1980 budgets (including debt servicing) on a per capita basis. Additional revenues above baseline revenues for Powder River and Rosebud counties are based on revenue to coal production ratios derived from a baseline run of the coal town model, which was generated by Keith Bennett. Additional revenues for Campbell County were generated by a coal revenue model developed by Thomas F. Stinson at the University of Minnesota.

c/ Because Ashland is an unincorporated community without a formal budget it is difficult to make reliable budget projections.

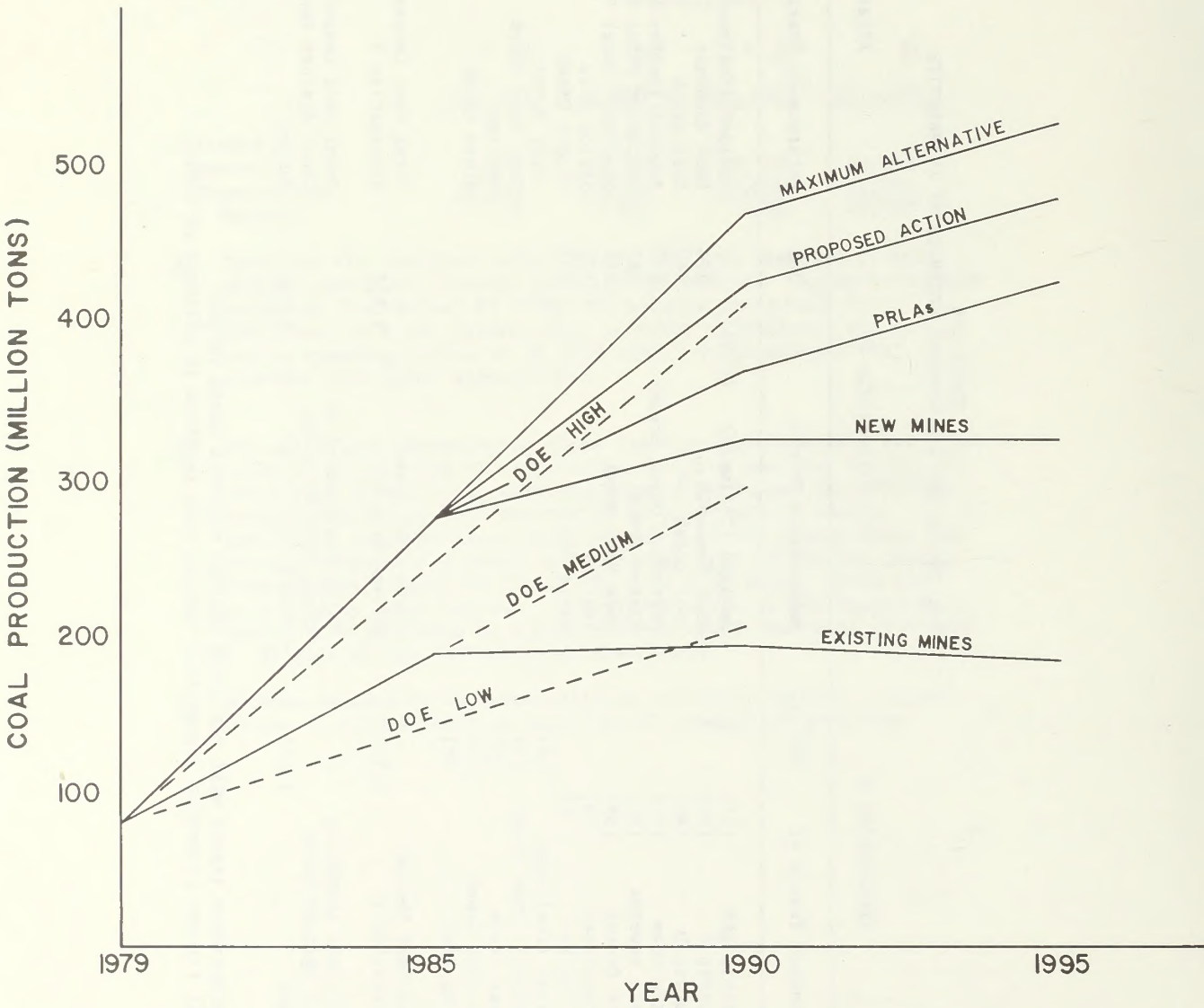
TABLE 2-4
COAL TRACTS AND RECOVERABLE RESERVES BY ALTERNATIVE

Alternative 2			Alternative 3		Alternative 4	
Maintenance Tracts a/		309 b/	Maintenance Tracts	309	Maintenance Tracts	309
Colstrip A&B	(15)		Ashland (Coalwood) (239)		Ashland (Coalwood) (239)	
Colstrip C	(20)		Cook Mountain	178	Cook Mountain	178
Colstrip D	(40)		Coal Creek	60	Coal Creek	60
Fortin Draw	(45)		Northwest Otter Creek	139	Ashland (Decker-Birney)	119
Little Rawhide	(90)		Timber Creek	187	Northwest Otter Creek	139
North Decker	(59)		Duck Nest Creek	316	Southwest Otter Creek	130
Spring Creek	(35)		Keeline	175	Spring Draw	383
West Decker	(5)		Kintz Creek	193	Timber Creek	187
Ashland (Coalwood)		239			Rocky Butte	445
Northwest Otter Creek		139			Duck Nest Creek	316
Timber Creek		187			Keeline	175
Duck Nest Creek		316			Kintz Creek	193
Spring Draw		383				
Total Coal Leased Alternative 2		1,573	Total Coal Leased Alternative 3	1,557	Total Coal Leased Alternative 4	2,634
Total Coal Leased to Count Against Lease Target		1,264	Total Coal Leased to Count Against Lease Target	1,248	Total Coal Leased to Count Against Lease Target	2,325

a/ Maintenance tracts will not count against regional lease target.
b/ All figures represent uncommitted federal coal reserves in millions of tons.

FIGURE 2-1

POWDER RIVER REGIONAL COAL PRODUCTION TO 1995



CHAPTER 3

DESCRIPTION OF THE AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes the affected environment for the area of the Powder River Region that is necessary for assessing effects of the No-Action Alternative in Chapter 4. Climate, physiographic province, geologic structure, fisheries, prime farmland, wetlands, floodplains, and threatened or endangered plant species either would not be regionally affected or do not occur within the region. Therefore, no assessments on these elements were deemed necessary.

Areas of land have been identified as possible alluvial valley floors (AVFs). Although these possible AVFs are not excluded from consideration for leasing, the OSM would make a final determination prior to the mine and reclamation plan approval regarding their existence and whether mining would be permitted in that area of the tract. Individual tract profiles (Northwest Otter Creek, Southwest Otter Creek, Ashland (Decker-Birney), Keeline, Kintz Creek, and Duck Nest Creek) show location of these possible AVFs (BLM, 1981).

GEOLOGY AND OTHER MINERALS

The economic coal beds are found in the Tongue River member of the Paleocene (65 to 55 million years ago) Fort Union Formation and the Eocene (55 to 38 million years ago) Wasatch Formation. Description and relationships of the coal bearing formations may be found in Brown (1962), and Matson and Pinchock (1977).

Faults and folds are rare and mostly confined to the west flank of the region along the edge of the Bighorn Mountains. The region is classified as aseismic (no earthquake tendency) (Simon, 1972).

The coal beds found in the region are generally thick and of very wide areal extent. Detailed discussions concerning the quantity, quality, correlations, and locations of the coal beds may be found in Glass (1976 and 1980); Matson and Blumer (1973); Matson and Pinchock (1977); Cole, Matson and Pederson (1980); and the Tract Profiles (BLM, 1981).

Abundant plant and invertebrate fossils are found in the Tertiary coal bearing rocks. Vertebrate of other significant fossils are rare and known from only a few locations. Those known fossils contained within the region have no exceptional scientific interest or value (BLM, 1979a; USGS, 1979).

Other minerals of economic importance found in the region are oil and gas, uranium, and bentonite (see discussion in Chapter 1).

WATER RESOURCES

Most of the water used in the Powder River Region comes from the Yellowstone River and its tributaries the Tongue River and Powder River; the Cheyenne River and its tributary the Belle Fourche River, and the North Platte River. The discharge of these streams is adequate to supply present needs within the region. Total water use in 1980 was about 518,140 acre-feet. The largest use, 81 percent, was for irrigation. Coal mining used 1,700 acre-feet, and municipal water use was 23,000 acre-feet. About 70 percent of the municipal water used is discharged as treated sewage effluent (BLM, 1979a).

Ground Water

The occurrence of ground water within the Montana and Wyoming areas of the Powder River Region is similar and therefore both areas will be assessed as a single unit. Ground water is used for domestic and stock watering, municipal supplies, secondary recovery of oil, irrigation, mining, milling, and other industrial uses.

Aquifers are contained in formations with a total thickness of more than 9,000 feet. The deepest aquifers are in the Madison aquifer system that includes geologic units from Precambrian-age basement rocks to Cretaceous-age shales (BLM, 1981, pp. 3-2). The most important aquifer within this system is the Madison Group, which is present in an area of over 180,000 square miles including the Powder River Region. The Madison aquifer is composed almost entirely of carbonates that are mostly dense with low porosity and permeability. However,

well developed zones of secondary porosity and permeability and localized beds of coarsely crystalline dolomite exist. Yields of more than 1,000 gallons per minute (gpm) are available where caverns, fractures, and crystalline zones are present; where they are absent, yields are much lower.

Most of the recharge to the Madison aquifer system is in outcrop areas in the Black Hills and Bighorn Mountains. The water becomes progressively more mineralized with increasing distance from the recharge areas. Discharge is from springs, wells, and seepage into stream valleys.

Water from the Madison aquifer system is used by the towns of Douglas and Gillette, Wyoming.

A sequence of Cretaceous shale up to 5,500 feet thick with very low vertical hydraulic conductivity overlies the Madison aquifer system and separates it from shallow aquifers. The shallow aquifers are contained in the Fox Hills Sandstone and Hell Creek, Fort Union, Wasatch, and Lance Formations. (BLM, 1979a, Figure R2-4).

Ground water in the above formations is available at relatively shallow depths in most of the region in sufficient quantity for domestic and stock watering uses. The quality of the water in shallow aquifers is highly variable. Larger yields and better quality water are usually more available in the lower part of the shallow aquifers than in the upper part. Stock and domestic wells are commonly less than 1,000 feet deep and yield about 25 gpm. Industrial and municipal wells are commonly deeper than 1,000 feet and are often 3,000 to 5,000 feet deep and open to several formations. These deeper wells can yield more than 100 gpm.

The aquifers most commonly used in the region are sandstone and coal beds in the dominantly fine-grained Fort Union Formation. (USGS, 1979, pp. II-18.) The sandstone beds are lenticular and generally do not extend more than a few miles; whereas, coal aquifers are more areally extensive. The Fox Hills-Hell Creek aquifer, which underlies the Fort Union Formation, is the most extensive unit where yields of 100 to 200 gpm can be obtained. Clinker zones in the Fort Union Formation are very permeable; however, they are usually above the water table.

Recharge to the shallow aquifer system is mainly in upland areas through sandy zones of the Fort Union Formation, coarse-grained alluvium, and clinker.

Downward movement of recharge water in the shallow aquifer system is retarded by shale layers of low permeability causing the static water level in wells in recharge areas to be progressively lower with increasing depth of the well. Pumping lifts in deep wells may be several hundred feet greater than in adjacent shallow wells. Perched zones are common, and where impermeable beds are exposed, ground water is discharged as seeps and springs.

The chemical quality of the water from the shallow aquifers is highly variable. DS concentration ranges from 100 to more than 8,000 mg/L, but Hodson and others (1973) state that the DS content of water from most wells is between 500 and 1,500 mg/L. As water moves downward through the formations, the chemical type is changed by cation-exchange softening and sulfate reduction. The water from wells less than 200 feet deep generally is hard (calcium-magnesium-sulfate type) whereas, water from deeper wells generally is soft (sodium-bicarbonate type) (BLM, 1979a, Fig. R2-12). Water from the deeper wells is typically lower in total DS, indicating that precipitation occurs as the water moves downward. Ranges of trace elements and radiochemical analyses of water from shallow aquifers in Wyoming are given in the Eastern Powder River Coal ES (BLM, 1979a, Table R2-7).

Quaternary alluvium contains the shallowest aquifers in the region. Most alluvium is too fine-grained to yield much water; however, clean, coarse-grained material along rivers may yield up to several hundred gpm. Recharge to alluvial aquifers is from precipitation, runoff, and upward seepage from underlying formations. Discharge is by evapotranspiration, seepage into streams, pumpage, or ground water flow to older formations.

The water table in alluvial aquifers can slope toward or away from a stream depending on whether the stream is gaining or losing water in that area.

The quality of the water in most alluvial aquifers is poor, with DS concentration exceeding 8,000 mg/L. The chemical type of the water is similar to that in the upper part of the shallow aquifers but may be higher in DS due to concentration by evapotranspiration

Municipal water supplies within the towns of Ashland, Broadus, and Gillette are adequate for the present population.

In some areas of Wyoming, uranium mining may result in serious and long-lasting degradation of water quality. Leachate from tailing ponds is well beyond the safe limits of radioactivity for animals or humans. Stock or humans using water from wells or streams down gradient could be exposed to dangerous levels of radioactivity. Increasing the danger is the nondegradable and cumulative character of this type of contamination. Plants, crops, and river biota accumulate and concentrate radium 226. Levels of radium 226 in some wells near uranium mines vary from less than 10 to 50 picocuries per

liter, and surface-water levels are as high as 35 picocuries per liter. U.S. Public Health Service limits are 3 picocuries per liter.

Surface Water

Montana

The major tributaries to the Yellowstone River that drain the Montana part of the region are Armells and Rosebud creeks and the Tongue and Powder rivers. Pumpkin, Otter, and Hanging Woman creeks are major tributaries to the Tongue River, and Mizpah and the Little Powder River are major tributaries to the Powder River. Streams that are perennial, or nearly so, include the Tongue and Powder rivers and Rosebud, Otter, and Hanging Woman creeks. Many streams are ephemeral (flow in response to rainfall or snowmelt). However, most stream channels have intermittent reaches that flow for long periods each year at very low rates.

The average runoff ranges from about 0.01 cubic feet per second per square mile (cfsm) to 0.06 cfsm from the larger drainages with the exception of the Tongue River which averages 0.35 cfsm at the state line near Decker, and 0.08 cfsm at Miles City. High runoff usually results from snowmelt and spring rains, and the extreme low-flow period is from October through January. Average flow for the Yellowstone River at Miles City is 11,605 cubic feet per second (cfs) (USGS, 1980a). Surface runoff is depleted by numerous stock-water reservoirs and spreader systems on small tributaries. Much of the flow that originates within the region is depleted by storage, evapotranspiration, and seepage.

The chemical quality of water in most small streams is poor most of the time (BLM, 1979a). The base-flow component (water that enters streams from the ground water system) of streams that drain the more arid areas contain DS concentrations ranging from 1,500 to 5,000 milligrams per liter (mg/L), mainly sodium sulfate. Rosebud Creek and the Tongue River are the only major streams that regularly contain DS concentrations less than 1,000 mg/L, mainly calcium bicarbonate; however, water in the Tongue River deteriorates in the downstream direction owing to irrigation return water that contains greater concentrations of DS, mainly sodium sulfate (BLM, 1979a). DS for the Yellowstone River averages about 480 mg/L below Miles City. Sediment yields range from 0 to 1.2 acre-feet per square mile per year (BLM, 1981). Fecal coliform count in colonies per 100 milliliters for October 1978 through September 1979 ranged from 960 to 30 in the Tongue River at the state line near Decker and 18 to 2 in the Yellowstone River at Forsyth (USGS, 1980a).

Wyoming

The Wyoming area of the region is drained to the east by the Belle Fourche and Cheyenne rivers, to the north by the Little Powder River, to the west by tributaries to the Powder River, and to the south by tributaries to the North Platte River. Most streams are ephemeral. However, many stream channels have intermittent reaches that flow for long periods each year at very low rates. Streams seem to be drier (closer to truly ephemeral) in the southern part of the region and become progressively wetter to the north (BLM, 1979a).

The average runoff ranges from about 0.01 to 0.02 cfsm from the larger drainages. The flow of the North Platte River at Casper, which is partially controlled by reservoirs, averaged 1,360 cfs in 1979. High runoff usually results from snowmelt and spring rains, and the extreme low-flow period is from October through January. Surface runoff from the region is depleted by numerous stock-water reservoirs and spreader systems on small tributaries (BLM, 1979a). Much of the flow that originates within the region is depleted by storage, evapotranspiration, and seepage. The quantity of flow that leaves the eastern Powder River Region via the large streams represents about 42 percent of the flow that originates on each square mile within the region (BLM, 1979a).

The chemical quality of water in most streams is poor most of the time. The base-flow component (water that enters streams from the ground water system) of most streams contains DS concentrations ranging from 1,500 to 5,000 mg/L, mainly sodium sulfate. DS for the North Platte River averages about 400 mg/L below Casper. Fecal coliform count in colonies per 100 milliliters for October 1978 through September 1979 ranged from 130,000 to 12,000 in Goose Creek below Sheridan, 10,000 to 11 in the North Platte River below Casper, 670 to less than 1 in the Cheyenne River near Riverview, 600 to 2 in the Belle Fourche River below Moorcroft, and 120 to 2 in the Little Powder River above Dry Creek near Weston (USGS, 1980b). Sediment yields range from about 0.1 to 3 acre-feet per square mile per year (BLM, 1979a).

AIR QUALITY

A detailed description of air quality in the region may be found in the Technical Report (Radian, 1980).

Background concentrations for TSP, NO_2, SO_2, non-methane hydrocarbons (NMHC), and ozone (O_3) were generated from monitoring data obtained within the region. Data on other criteria pollutants, carbon monoxide (CO) and lead (Pb), were gathered from nearest available sites, which are Billings, Montana (about 120 miles from Ashland, Montana), and Steamboat Springs, Colorado (about 400 miles from Gillette, Wyoming), respectively (Radian, 1980).

The region is a Federal Class II PSD area. However, the Northern Cheyenne Indian Reservation, which is a Class I PSD area, is bordered by the region on the north, east, and south sides.

Appendix A (Table A-1) shows the maximum allowable increases for the PSD of air quality. Appendix A (Table A-2) shows the federal, Montana, and Wyoming ambient air quality standards.

The rural TSP annual geometric mean for the region is about 16 $\mu g/m^3$. In and near populated areas and existing industrial activities, particulate levels are significantly higher than background levels. Particulate readings near existing mining activities are higher than background levels due to fugitive dust generated by mining operations. TSP returns to rural background levels several miles downwind as a result of particulate deposition.

Violations of the annual and 24 hour TSP standard occurred in 1979. In Wyoming the east monitor site at Black Thunder Mine exceeded annual and 24 hour TSP standards (412 and 113 $\mu g/m^3$, respectively). The Belle Ayr Mine sites 4 and 5 and Eagle Butte site 4 exceeded the 24 hour TSP standard (188, 167, and 152 $\mu g/m^3$, respectively). In Montana, the Colstrip area does not meet NAAQS for particulate and has been designated a nonattainment area which is not expected to improve in the near future.

Rural annual SO_2 and NO_2 background levels are about 1 and 16 $\mu g/m^3$, respectively. The 3-hour national standard for NMHC was exceeded five times at Colstrip in 1976 with a maximum of 0.87 parts per million (ppm). These high readings are attributed to heavy vehicular traffic primarily in the early morning. CO, Pb, and O_3 concentrations were less than 50, 80, and 75 percent, respectively, of the NAAQS.

Visibility greater than 60 miles is common. Significant reductions in visibility are generally weather related.

SOILS, VEGETATION, AND RECLAMATION

Soils of the region have developed mostly with short-grass vegetative cover common to the semiarid Great Plains. Due to prevailing climate and vegetative conditions, organic matter is accumulated slowly, and soils have developed with light-colored surfaces. Light colored soils generally indicate low organic matter content and fertility levels. Subsoil colors are normally light brown or reddish brown, and are often influenced by white, powdery carbonate accumulations caused by low rainfall and insufficient leaching. Soils of the region are mostly residual (developed in place) and formed from weathered sedimentary bedrock, mostly sandstone and shale. Most soils in the region have a fairly good reclamation potential based on reclamation success of other mines in the region. The 'fairly good' category means on a scale of 1 to 10 these soils rate a '7'. Site-specific information on soils and reclamation potential is available in the Tract Profiles (BLM, 1981); Wyoming General Soils Map (University of Wyoming, 1977); and *Rehabilitation Potentials and Limitations of Surface-Mined Land in the Northern Great Plains* (Packer, 1974).

The major vegetation types in the Powder River Region are shown on Table 4-6, along with acreage. Refer to the Tract Profiles (BLM, 1981) for vegetation map and common species list for the vegetative types. No threatened or endangered plant species have been identified within the region (BLM, 1981; Dorn, 1980).

WILDLIFE

Physical boundaries used in assessing wildlife impacts are the Decker, Colstrip, and Otter Creek areas in Montana, and antelope (and corresponding deer) hunt areas 24 and 101 (21), 17, 18 and 19 (17 and 18) and 23 (19 and 20) in Wyoming (see Appendix B). Acres of habitat for these areas are shown on Table 3-1.

Montana

Detailed population data is not available for Montana.

In the Colstrip area big game may well be below their numbers of 1976 following the two severe winters of 1977-78 and 1978-79 (Wentland, 1980). Mule deer habitat use is heaviest in areas south

and east of Colstrip. This area is fair to poor antelope habitat. Mule deer are common on the breaks along both sides of Otter Creek. Most deer appear to winter on the Custer National Forest. Antelope are common on the west side of the creek, south of the confluence of Three Mile Creek and Otter Creek (Martin, 1980). The West Decker and Spring Creek mines include or are directly adjacent to important winter mule deer and antelope range. During the severe winter of 1977-78, approximately 405 mule deer and 375 antelope used these areas (Phillips, 1979).

Sharp-tailed grouse are abundant (11 leks) in the Colstrip area. The habitat consists of pine groves which provide escape and thermal cover while native grasslands and cultivated lands provide nesting cover and food habitat. The grouse have established new leks on unmined areas near Colstrip Mine and are nesting on successfully reclaimed areas. Twenty sharp-tailed grouse leks have been located in the Otter Creek area. This amounts to .22 leks per square mile compared to .12 leks per square mile in the Colstrip area. Average male attendance was about 18 per lek in 1980 (Martin, 1980). One sage grouse lek exists on the Spring Creek lease, but under mitigation agreement between Montana Fish and Game Department and NERCO, this lek area was determined unsuitable for mining with the exception applied (personal communication, Richard Zander, BLM, Miles City, 1981).

Red-tailed hawks are the most common raptor in the Otter Creek area with eight nests known to occur. Seven golden eagle nests are in this area but only one nesting pair was observed in 1980. Two prairie falcon eyries exist with one being active in 1980 (Martin, 1980).

No threatened or endangered species are known to exist within the Montana area.

Wyoming

The majority of coal mining related surface disturbance is occurring in antelope hunt areas 24 and 101 with six mines operating in the area (Appendix B (Figure B-1), and the Regional Activity Map). The Gillette-Orin Junction main line railroad bisects these two areas, and because it is fenced, it severely restricts east-west movement. Access roads to the mines intersect the railroad seven times and subdivide hunt area 24 into several small pastures. Movement between these pastures is severely restricted by traffic, fences along access roads, and the railroad. Seasonal movement is southward in the fall and northward in the spring. Approximately 200 to 300 antelope have wintered in the vicinity of Keeline and Kintz Creek tracts.

Two mines are currently located in antelope hunt area 17 north of Gillette. Antelope distribute evenly throughout hunt area 17 with exceptions of the scoria hills and timbered areas along the Little Powder River which are occupied infrequently.

Mule deer use (deer hunt area 18) is heaviest in the rough scoria hills and timbered breaks along the Little Powder River. White-tailed deer are common in the Little Powder River valley. However, both species show little seasonal movement.

Population trends of big game are presented in Table 3-2. Most big game herds in northeastern Wyoming suffered heavy winter losses following the winters of 77-78 and 78-79.

Sage grouse are the most common upland game bird in Campbell County. Forty-one leks are known to exist in the county with 16 of these existing in the area southeast of Gillette (antelope hunt areas 24 and 101). Five of these leks have been abandoned and two others destroyed by coal mining related activities since 1975 (Wyoming Game & Fish, 1979c). Sharp-tailed grouse are common in the northern half of Campbell County with three lek sites known. Data for the remainder of the county are not available.

Golden eagles, red-tailed hawks, ferruginous hawks, and great-horned owls are the most common nesting raptors in Campbell County. Available data indicate a minimum of 90 pairs of nesting golden eagles, 21 pairs of red-tailed hawks, and 21 pairs of great-horned owls. There are 13 pairs of golden eagles nesting on or within ½ mile of active mines or areas leased for further development.

The bald eagle and the black-footed ferret are listed as endangered by Fish and Wildlife Service and occur within Campbell County. The bald eagle is a common winter resident. The black-footed ferret is considered rare since there have been few reported sightings. However, no habitat has been designated as critical for either of these threatened or endangered species. No other threatened or endangered animal species are known to exist in the Wyoming area.

CULTURAL RESOURCES

Cultural resources within the region include evidence of man's activities for the past 12,000 years (BLM, 1979b, pp. 4-27). Specific types of cultural resources known are stratified sites resulting from repeated occupation of a locality, bone beds from communal hunts when large numbers of animals were killed, stone circles generally known to be as-

sociated with skin-covered dwellings of late prehistoric and historic Indians, rock art, ceramic sites where pottery is found, quarries where raw material for stone tools was collected, lithic scatters that provide evidence of short-term subsistence activities, rock shelters, burials, rock cairns or piles of rocks of debatable function, battlefields, homesteads, mines, and trails (BLM, 1979a; USGS, 1979). Appendix C shows the identified cultural sites for the Powder River Region.

VISUAL RESOURCES

Intrusions in an area affect the form, line, color, and texture of the landscape. Intrusions are classified as high, medium and low depending upon the amount of contrast with the existing landscape. Intrusions of high contrast would include open pits, coal silos and conveyors, structures on the skyline, large reflective surfaces, and large areas of surface disturbance. Intrusions of medium contrast would include access and haul roads, railroad lines, power lines, drilling rigs, and oil wells. Intrusions of low contrast would include fence lines, pipelines, and small areas of surface disturbance.

Montana

This area is characterized by rolling uplands dissected by steep-sided valleys. Local rugged hills and ridges are capped by resistant sandstone and clinker. Badlands have been formed in easily eroded shales. The region is drained by northward flowing tributaries of the Yellowstone River (see Regional Activity Map). Scenic quality ratings and management classes have not been established for this area of Montana; however, potential is for scenic quality Classes B and C, and management Classes III and IV with some areas of Class II possible (VRM Manual 8400 and Appendix D).

Wyoming

This area is characterized by low rolling hills and flat plains sometimes broken by canyons, buttes, and breaks. Scoria outcrops provide some reddish contrast to the landscape. Water is scarce and rarely a dominant feature. This area is largely scenic quality Class B or C and management Class III or IV. A management class map for Campbell and Converse counties is included in the Eastern Powder River Coal ES (BLM, 1979a).

LAND USE

Agriculture is the primary land use in the region (USGS, 1979). Most of the land is used as range for cattle and sheep. Farming consists mainly of dryland hay, both grass and alfalfa, or grain. Some flood irrigation of hay and grain fields occurs along stream bottoms. Other land uses and designations include mining, oil and gas, transportation networks, national forest, Indian reservations, recreation areas, and urban areas.

Agriculture

In Montana, 87 percent of the land in the counties within the region is used for agricultural purposes (USDA, Montana Department of Agriculture, 1978). Of that total land, 88 percent is rangeland, 6 percent dryland farming, 1 percent irrigated and the remainder miscellaneous agricultural uses. The acres within these types of land uses are shown on Table 3-3 by county. Productivity on these lands can only be estimated because of flucuations caused by climate, markets, and operational decisions. In 1979 there were about 279,000 cattle within the region. Cropland productivity average is 1.9 tons per acre for hay, 25.0 bushels per acre for wheat, 35.8 bushels per acre for barley, and 45.3 bushels per acre for oats based on 1979 crop production figures.

Also, in Wyoming 87 percent of the land in the counties within the region is used for agricultural purposes (USDA Wyoming Crop Production Reporting Board, 1978). Of that, rangeland for cattle and sheep accounts for 90 percent, dryland farming 5 percent, irrigated land 1 percent and the remainder is in miscellaneous agricultural uses. The acres within these types of land uses are shown on Table 3-3 by county. Productivity on these lands can only be estimated because of flucuations caused by climate, markets, and operational decisions. In 1979 there were approximately 438,000 cattle in Wyoming. Cropland productivity average is 1.48 tons per acre for hay, 22.5 bushels per acre for wheat, 30.2 bushels per acre for barley and 44.2 bushels per acre for oats based on 1979 crop production figures.

There are no prime farm or wet lands (USDA, SCS, 1981).

Other Land Uses

Land use for oil and gas, power plants, refineries, and mining of coal, bentonite and uranium is increasing in the region. In 1980, 76,338 acres in the Wyoming and 23,519 acres in the Montana were included in these types of activities.

RECREATION

The Powder River Region is comprised mostly of privately owned surface, which limits public access and use. Recreational use is confined to the developed sites in the region or the national forests on the fringes of the region. The present number of facilities are adequate to meet current use or demand.

Montana

Hunting occurs throughout the area and receives more participation than any other single recreational activity. Big game hunter success is high (see Appendix E); approximately 75 percent for antelope (Montana Fish and Game, 1978). Other outdoor recreation opportunities include fishing, water sports, camping, picnicking, hiking, winter sports, historic interpretation, and municipal parks (Montana Fish and Game Department, 1978; USDA, Committee for Rural Development, 1975; USDA, Big Horn County Committee for Rural Development, 1976; USDA, Soil Conservation, 1976; USGS, 1979).

Although there are no designated wilderness areas, the Forest Service (FS) has a wilderness proposal, the Tongue River Breaks Roadless Area, in Custer National Forest (USDA, RARE II, 1979). Also, BLM has three proposed wilderness areas: the Tongue River Breaks Contiguity (adjacent to the FS proposal), Zook Creek, and Buffalo Creek (both located between Ashland and Decker) (BLM, 1980a).

Wyoming

Like Montana, hunting is the major recreational activity with high success ratio of hunters to harvest (over 90 percent for antelope) (see Appendix E). A like variety of outdoor recreation opportunities are also available (BLM, 1979a; Wyoming Recreation Commission, 1975 and 1980; Wyoming Game and Fish, 1977a and b, 1978a and b, 1979a and b, Campbell County Recreation Board, 1974; City of Gillette, 1978).

The FS has proposed the Laramie Peak (Medicine Bow National Forest) and the Seven Brothers (Bighorn National Forest) wilderness areas (USDA, RARE II, 1979). The Cloud Peak primitive area is managed by the FS (Bighorn National Forest). BLM has three areas under study for possible wilderness designations: Fortification Creek (west of Gillette), Gardner Mountain and the North Fork of the Powder River (both located south of Gillette) (BLM, 1980b). BLM also has a special management unit: the Middle Fork of the Powder River.

TRANSPORTATION

Railroads

BN operates three main lines on which unit trains travel within the Powder River Region. The northern line runs through Billings and Miles City, Montana, and into North Dakota and Minnesota. The central route runs through Sheridan and Gillette, Wyoming, and into Nebraska, Iowa, Missouri, and Illinois. The southern route runs through Orin Junction and Guernsey, Wyoming and into Nebraska and Colorado. The number of TPD along these lines in 1981 are shown on Table 3-4. These trains reflect both freight/passenger and unit coal train traffic loaded and empty.

A unit train, which contains 100 cars with a capacity of 100 tons each, is approximately 1 mile in length. At any given crossing it would take a unit train 3 minutes to pass traveling at 20 miles per hour and 12 minutes at 5 miles per hour (BLM, 1979a). At these two speeds, a crossing on the central route leaving the region would be interrupted for 1 hour 12 minutes and 4 hours 40 minutes, respectively. Data are unavailable for car-train accident rates for specific at-grade crossings. An average rate for a crossing with flashing lights has been predicted for a traffic volume of 1,000 motor vehicles per day. Table 3-4 shows the existing situations at four selected cities located along BN main lines.

Two proposed railroad lines, the Tongue River Railroad along the Tongue River in Montana and the Chicago Northwestern/Union Pacific line in southeast Wyoming, would also handle coal traffic.

Highways

In Montana, the major trafficways are Interstate 94, U.S. Highway 212, Federal Aid Primary (FAP) 39, U.S. Highway 312, and FAP 92. Outlying areas are connected by a system of county, FS, Indian reservation, and private roads. Appendix F (Figure F-1) shows the interstate, state, and federal aid primary and secondary road systems, and average daily traffic (ADT). Highway 212 from Ashland through the Northern Cheyenne Indian Reservation contains potholes, ruts, and shoulder deterioration creating traffic safety and nuisance problems. The Native Americans along with other local residents are concerned about the problems caused by heavy truck traffic along this route. The same situation exists along FAS 314 between 212 and Decker. This road was once surfaced but large traffic volumes and heavy loads have deteriorated it. This road is also a traffic safety and nuisance problem (Northern Cheyenne and Crow tribal councils).

In Wyoming, the major north-south trafficways are Interstate 25 and State Highway 59 (Regional Activity Map). East-west travel is largely on Interstate 90, U.S. 16, State Highway 387, and State Highway 20/26. Appendix F (Figure F-2) shows interstate, U.S., and state highways, and the ADT for the Wyoming area. A network of county and private roads connect outlying areas to these major transportation routes. There are grade separations along the BN line in Gillette, Casper, and along State Highway 59 (between Douglas and Wright), which allow train interruptions to avoid highway traffic. Roads in the region are often rutted and deteriorated from extensive use of heavy, energy-related equipment. Highways 59 and 387 are being upgraded.

NOISE

Noise was calculated by using the equations discussed in 'Noise Impact Analysis' (Rau and Wooten, 1980). The affected zone encompasses areas in which the Ldn (decibels weighted on a day-night basis) exceeds 55 dBA ("A" weighted decibels). The 55 dBA is a standard set by the U.S. Environmental Protection Agency as a long-term limit for protection of health and welfare. A normal conversation is equivalent to 50 to 60 decibels.

Railroads

The distances from railroad track center line to the 55 dBA contour zone are:

Miles City, Montana (Northern Route)	2,500 feet
Gillette, Wyoming (Central Route)	2,100 feet
Newcastle, Wyoming (Central Route)	4,000 feet
Torrington, Wyoming (Southern Route)	3,400 feet

Highways

Noise levels were calculated using the equations discussed in 'Noise Impact Analysis' (Rau and Wooten, 1980). The distance to the 55 dBA contour from the road center line has been calculated for the following cities within the

Gillette, Wyoming	250 feet
Sheridan, Wyoming	1,000 feet
Ashland, Montana	100 feet
Colstrip, Montana	100 feet
Decker, Montana	800 feet

SOCIOLOGY

Social Organization

Social organization is discussed for the three communities, Ashland (Rosebud County), Broadus (Powder River County), and Gillette (Campbell County), that would be affected from any of the alternatives described in Chapter 2.

Ashland and Broadus, Montana, (see Regional Activity Map) are rural communities and have received very little population increase over the past decade. Also, Ashland is an unincorporated community. In both communities interpersonal relationships are on an informal basis. Friendship networks are dense, which means a community resident knows just about everyone else in the community.

The Northern Cheyenne and Crow Indian reservations are located in the northwestern part of region (see Regional Activity Map). Since Ashland is located adjacent to the eastern boundary of the Northern Cheyenne Reservation, most of the town's occupants are Native Americans.

Gillette, Wyoming, has grown rapidly since the 1960s which has already changed the social organization considerably. Interpersonal relationships are formal. A community resident knows relatively few others in the community, and friendship ties are made on the basis of occupation, age, and religion (Laumann, 1973; Wellman, 1979).

Community Services and Facilities

Table 3-5 shows the existing levels of community services and facilities. Water and sewage facilities are adequate to support the present population (see Water Resources). Fire protection throughout most of the region is gained through a volunteer force.

Ashland (Rosebud County) does not currently have a high school. Students attend private and parochial schools in Colstrip and Broadus.

Housing

See Table 3-6 for the existing number of dwelling units in the Powder River Region.

Attitudes

Overall, people who were interviewed within the region favored coal development. A few respondents stated they would be in favor only if it was certain the coal was needed to help meet the nation's energy requirements. The main reasons given for favoring coal development were the economic benefits and the need to develop domestic energy resources. Economic benefits stated pertained to increased employment and increased tax base. A common response was that the coal is needed to help reduce the amount of imported fuel. Environmental concerns expressed were regarding reclamation of the land, and water quantity and quality. Concern was also expressed regarding the impacts from the influx of population (especially in Montana). A more detailed description of attitudes within specific areas is given in the individual Tract Profiles (BLM, 1981).

ECONOMICS

Montana

Table 3-6 presents a synopsis of the existing 1980 economic environment for the Montana area of the region. Coal employment numbered 950 in Big Horn County, and 380 in Rosebud County, as reported by the Montana Employment Security Division of the Department of Labor and Industry. Actual coal employment for Powder River County is not discloseable; however, a baseline run from the Coaltown model, developed by Lloyd Bender and others at Montana State University, estimated Powder River County coal employment to be 15.

Wyoming

Table 3-8 presents a synopsis of the existing 1979 economic environment for the Wyoming area of the region. Coal employment numbered 1,672 in Campbell County, 155 in Converse County, and 302 in Sheridan County, as reported by the Wyoming Department of Economic Planning and Development (DEPAD).

TABLE 3-1
ACRES OF WILDLIFE HABITAT

Location	Acres
MONTANA	
Colstrip Area	288,000
Decker Area	256,000
Otter Creek Area	59,000
WYOMING	
Hunt Areas:	
Antelope 24 & 101	750,080
(Deer 21)	750,080
Antelope 17	1,099,520
(Deer 17 & 18)	1,758,020
Antelope 23	851,840
(Deer 19 & 20)	1,158,400

TABLE 3-2
POPULATION TRENDS
BIG GAME - CAMPBELL COUNTY, WYOMING

Antelope Area 24	1975	1976 (% change)	1977 (% change)	1978 (% change)	1979 (% change) 75-79
Area Harvest Pumpkin Buttes	1,981	2,545 (+28.5)	1,937 (-23.9)	1,893 (-2.3)	1,226 (-38.2)
Herd Unit Harvest	5,821	6,391 (+9.8)	5,264 (-17.6)	6,305 (+19.8)	5,915 (0)
% Area Harvest of Herd Unit	34%	39.8	36.8	30	20.7
Area 17					
Area Harvest Powder River	3,018	2,983 (-1.2)	1,716 (-43.5)	1,627 (-5.2)	1,071 (-64.5)
Herd Unit Harvest	3,849	4,044 (+5.0)	2,687 (-33.6)	2,690 (0)	2,156 (-44)
% Area Harvest of Herd Unit	78.4	73.7	63.8	60.4	49.6
Mule Deer **Area 21**					
Area Harvest Black Hills	978	878 (-10.2)	736 (-16.2)	498 (-22.3)	316 (-67.7)
Herd Unit Harvest	4,404	3,759 (-14.6)	3,003 (-20.1)	1,807 (-39.8)	1,349 (-69.4)
% Area Harvest of Herd Unit	22.2	23.4	24.5	27.6	23.4
Area 18					
Area Harvest Powder River	3,828	2,178 (-43.2)	1,876 (-13.9)	1,069 (-43.1)	749 (-80.5)
Herd Unit Harvest	9,418	8,489 (-9.9)	6,206 (-26.9)	4,790 (-22.8)	3,671 (-62.1)
% Area Harvest of Herd Unit	34.3	25.6	30.2	22.3	20.4

TABLE 3-3
AGRICULTURAL LAND USE ACRES

County	Total Acres	Cropland	Range	Irrigated	Woodland	Miscellaneous [a]
Wyoming						
Campbell	3,034,614	157,490	2,676,971	4,176	31,056	11,985
Converse	2,653,284	76,794	2,351,058	53,364	15,280	21,034
Sheridan	1,598,195	124,590	1,213,733	54,448	11,129	13,580
Johnson	2,620,817	43,768	1,861,688	40,495	8,683	17,977
Natrona	3,713,764	57,320	3,023,890	37,493	3,073	26,147
Crook	1,804,338	165,176	1,193,768	8,712	150,685	16,721
Weston	1,478,109	53,828	1,311,350	6,427	83,040	16,511
Total	16,903,121	678,966	13,632,458	205,115	302,946	123,955
Montana						
Big Horn	3,214,720	286,739	2,329,017	49,275	[b]	[b]
Rosebud	3,223,424	182,827	2,778,398	38,838	63,890	43,869
Powder River	2,104,128	165,988	1,353,409	9,106	13,737	11,777
Total	8,542,272	635,544	6,460,824	92,219	77,627 [c]	55,646 [c]
REGION TOTAL	25,445,393	1,314,520	20,093,282	297,334	380,573 [c]	179,601 [c]

[a] Includes farm buildings, pig lots, ponds, etc.
[b] Information Withheld.
[c] Big Horn County not included.

Sources: USDA, Wyoming Crop Reporting Board, 1978.
USDA, Montana Department of Agriculture, 1978.

TABLE 3-4
EXISTING TPD AND AT-GRADE CROSSING INFORMATION

Location	Trains Per Day	At-Grade Crossings Daily Interruptions 5 mph	20 mph	Car/Train Accidents a/ Per 100 Years
Miles City, MT	17	2 hrs 2 min	33 min	1
Gillette, WY	16	2 hrs	30 min	1
Newcastle, WY	30	4 hrs 48 min	1 hr 2 min	3
Torrington, WY	23	3 hrs 24 min	51 min	1 to 3

a/ Based on 1,000 vehicles daily.

Source: Trains per day information obtained from Peter Briggs, Burlington Northern (personal communication, 1981).

TABLE 3-5
EXISTING LEVELS OF COMMUNITY SERVICES AND FACILITIES

Service/Facility	Montana		Wyoming	
	Rosebud County	Powder River County	Campbell County	Natrona County
Law Enforcement (Sworn Officers)	14	4	56	124
Teachers	143	48	417	973
Physicians	3	1	20	96
Dentists	4	1	5	38
Hospital Beds	26 a/	0 b/	31 c/	282

a/ One hospital located in Forsyth.
b/ There is no hospital in Powder River County.
c/ Hospital operating at 52 percent capacity.

Sources: Powder River Comprehensive Plan (draft), 1981.
Rosebud County Plan, 1979.
Department of Economic Planning and Development.
Wyoming Department of Education, Wyoming Public Schools Fund Accounting and Reporting (1979-80).

TABLE 3-6
EXISTING NUMBER OF DWELLING UNITS a/

Montana b/	
Big Horn County	3,867
Hardin	1,360
Powder River County	1,123
Broadus	336
Rosebud County	3,787
Ashland District c/	248
Wyoming d/	
Campbell County	8,950
Gillette	4,650
Converse County	5,050
Douglas	2,210
Crook County	2,340
Moorcroft	415
Johnson County	2,960
Buffalo	1,635
Natrona County	27,200
Casper	19,400
Sheridan County	10,500
Sheridan	6,380
Weston County	2,830
Newcastle	1,420

a/ Includes mobil homes and multi-family housing.
b/ Estimate based on information from 1980 final census.
c/ Because Ashland is a small unincorporated town, census figures collected are for the surrounding district.
d/ Estimates based on the housing count from the 1980 preliminary census.

TABLE 3-7
THE EXISTING ECONOMIC ENVIRONMENT
FOR THE MONTANA COUNTIES IN 1980

	Coal a/ Production (million tons)	Total b/ Employment	c/ Population	Local Expenditure Levels d/ County ($1,000)	Schools ($1,000)	Towns ($1,000)
Big Horn County	18.5	5,583	11,088	6,109.5		
School					9,892.3	
Hardin			3,288			778.1
Powder River County	.03	1,245	2,523	3,887.5		
School					2,025.8	
Broadus			715			162.3
Rosebud County	24.8	5,021	9,965	6,392.5		
School					5,911.7	
Forsyth			2,550			1,341.0
Ashland			569			e/

a/ Miles City District Office, Miles City, Montana.
b/ Research and Analysis Section, Employment Security Division, Department of Labor and Industry, Helena, Montana.
c/ Preliminary 1980 census.
d/ Obtained from the respective counties, schools and towns. Includes debt servicing.
e/ Ashland is an unincorporated community without a formal budget.

TABLE 3-8
THE EXISTING ECONOMIC ENVIRONMENT
FOR THE WYOMING COUNTIES IN 1979

	Coal a/ Production (million tons)	Total b/ Employment	c/ Population	Local Expenditure Levels d/ County ($1,000)	Schools ($1,000)	Towns ($1,000)
Campbell County	41.0	12,453	23,200	13,681.1		
School District #1					35,885.2	
Gillette			11,500			10,122.0
Converse County	3.8	5,056	13,200	8,304.0		
School District #1					15,279.5	
Douglas			5,680			6,690.0
Crook County	-0-	1,461	5,200	3,467.4		
School District #1					4,578.5	
Moorcroft			1,010			384.0
Johnson County	-0-	2,099	6,600	2,062.3		
School District #1					5,646.8	
Buffalo			3,700			1,902.3
Natrona County	-0-	36,293	69,600	35,668.5		
School District #1					30,908.8	
Casper			49,300			41,792.5
Sheridan County	3.5	8,115	24,300	14,724.3		
School District #2					9,898.8	
Sheridan			14,700			7,143.8
Weston County	-0-	2,479	7,020	3,806.8		
School District #1			3,550		3,671.2	
Newcastle						1,662.8

a/ Published by the Wyoming Department of Economic Planning and Development.
b/ Published by the Wyoming Security Employment Commission.
c/ Estimate based on the 1980 population to employment ratio derived from the preliminary census from the U.S. Census Bureau. City estimates based on the 1980 town to county ratio.
d/ Obtained from the respective counties, schools and towns. Includes debt servicing.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter presents the scientific and analytic basis used in the comparison of alternatives described in Chapter 2. Site-specific effects of the individual tracts are contained in the Tract Profiles (BLM, 1981), which are available from the Casper District Office upon request. Description of the affected environment was used in assessing the No-Action Alternative (Alternative 1) which was, in turn, then used as the new baseline to assess Alternatives 2, 3, and 4. Analyses are focused on 1990; however, the time frame expands to 1995 when necessary for the worst-case analysis. Analyses presented in this chapter were made based on the professional judgments of the resource specialists when other sources or references were unavailable. Discussions are presented on a resource by resource basis; however, some resource discussions have been broken down further by alternative as necessary for clarity.

Also included in this chapter are adverse impacts which cannot be avoided should coal leasing occur, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and irreversible or irretrievable commitments of resources.

GEOLOGY AND OTHER MINERALS

The only major impact to geology would be the mining of the coal. The direct impact to topography is insignificant in itself, but would impact wildlife and is assessed in the Wildlife section of this chapter. Table 4-1a gives annual coal production projected for 1990 under each alternative. Table 4-1b shows production amounts for federal reserves only.

UNAVOIDABLE ADVERSE IMPACTS

Removal of the coal beds and destruction of overlying strata.

SHORT TERM VS. LONG TERM

There are no short-term impacts associated with geology. The long-term impact would be the loss of the mined coal reserves for future use.

IRREVERSIBLE/IRRETRIEVABLE

Coal once mined and consumed would be irreversible. Coal not mined and left due to lack of technology would be economically irretrievable once the mining has passed it by. Coal lost would equal 10-15 percent of the reserve base available for each alternative (Table 1-1).

WATER RESOURCES

Ground Water

Impacts to the ground water resources would occur primarily in the vicinity of the mined area and would have little effect on the regional ground water systems. Impacts include removal or modification of aquifers, interruption of ground water flow during mining, modification of flow after reclamation, and changes in water quality.

The impacts of uranium mines on the water resources of the region are discussed in detail in environmental statements dealing specifically with individual uranium mine plans; therefore, no further discussion of the subject is included in this regional analysis.

Mining of new federal coal would result in the removal of the lowest coal aquifer mined and all aquifers above it. Coal beds are usually the most extensive shallow aquifers in the region; whereas sandstone aquifers in the overburden and interburden are usually lenticular beds of relatively small areal extent.

Reclamation regulations require that the overburden and interburden (spoil) be replaced in the mine to restore the area to as nearly its original condition

as practical. The replaced spoil is usually moderately permeable unless it is unduly compacted during emplacement. Studies by Rahn (1975) indicate that dragline-laid spoil which undergoes gravity sorting and minimal compaction by machinery may be as much as a hundred times more permeable than scraper-laid spoil which is compacted by scraper wheels. Aquifers created by dragline-laid spoil can have a higher recharge rate and yield than the combined total of the original aquifers, while scraper-laid spoil aquifers may have lower recharge rates and yield than the original aquifers. Truck-shovel-laid spoil is in between in water-bearing characteristics. Thus the impact of removing aquifers in the mined areas can be mitigated by replacing spoil in a manner to create aquifers with water-bearing characteristics equal or superior to those of the original aquifers.

Coal mining would create a hole in the ground that will act as a large well if the mine extends below the water table. Water entering this "well" would be lost through evaporation, either naturally or as it is used for dust suppression or other mine purposes, or will be discharged to streams in dewatering operations. This discharge would create a lowering of water levels (cone of depression) in the vicinity of the mine. Pumping of standard-type wells to supply additional water for mine operations would increase the cone of depression.

The change in the water level surrounding the mine would depend on aquifer characteristics, recharge rates, and pumping rates. The greatest declines would be in the mine itself and would decrease with distance from the mine edges to negligible amounts within a few miles.

If the cone of depression caused by mining intersects a nearby stream, the hydraulic gradient of the water table can be reversed so that water moves from the stream toward the mine. A reduction in streamflow would result, but because of restrictions on mining alluvial valley floors and the generally low permeability of earth materials in the region other than alluvium, the reduction would be less than 1 percent.

Modification of ground water flow after reclamation results from breakup of the layering that generally occurs in native formations of the region and from modification of the slope of the land surface. In many parts of the region relatively impermeable shale layers interbedded with sandstone and coal cause perched zones of saturation to form. Where perching layers outcrop, springs or seeps occur. The replaced spoil is relatively uniform in composition so that vertical and horizontal permeability are similar, thereby eliminating perched zones and their springs and seeps and increasing recharge to the water table. The removal of springs and seeps from their former locations would affect the plants and animals that depended on the additional water at those locations. Springs and seeps might reappear at different locations after reclamation is completed or the extra recharge to the water table might discharge into streams. The overall impacts of mining would be to permanently change the pattern of ground water flow but mining would not permanently diminish the quantity of water available in the area of the mine.

The water in the spoil aquifer would be of poorer quality than the water in the original aquifers. This is because the disturbed spoil presents many fresh surfaces to percolating water and this causes solution of soluable minerals to occur at a higher rate. The solution rate would eventually return to normal levels; however, with the low levels of precipitation and recharge prevalent in the Powder River Region, this process may take many years, perhaps centuries. The ground water occurring naturally in the region varies greatly in mineral content both areally and with depth at a given location. Spoil aquifer water varies also, but generally is two to three times as mineralized as water from undisturbed coal aquifers but typically is no higher in mineral content than the most highly mineralized ground water in the area (personal communication, N.J. King, USGS, 1981).

Water in spoil material typically contains calcium-magnesium-sulfate with lesser amounts of sodium and bicarbonate; whereas, water in the coal aquifers typically contains sodium-bicarbonate. Calcium-magnesium-sulfate water containing as much as 3,000 mg/L of dissolved solids generally is unsuitable for domestic use but should have no deleterious effects on livestock and wildlife. Water containing as much as 7,000 mg/L would be highly cathartic and would be marginal for use by livestock and wildlife. Ground water that is of the sodium-bicarbonate type and lower in dissolved solids usually can be obtained by developing wells in aquifers below the spoil aquifer. However, pumping lifts and costs would be greater if the mine is in a recharge area.

Because of the low sulfur content of coal in the region, no acid mine-water drainage problems are expected (BLM, 1979a). Also, trace elements and heavy metals normally are filtered out of the ground water in mined areas by coal wastes and other carbonaceous materials in the spoil.

Where spoil aquifers discharge into a nearby stream, the increased salt load from leaching of the spoil can be significant and contribute to the salinity of the stream. However, where discharge is indirect to the upper reaches of an ephemeral stream far from its confluence with a perennial stream, it may take decades or even centuries before any effects

are noticed downstream. This is especially true where the natural DS concentrations of water in the alluvium underlying the stream is similar to that of the leachate from the spoil aquifer. The long-term effects of the movement of more highly mineralized water from the spoil aquifer into adjacent, undisturbed less mineralized aquifers is not clearly understood. However, a significant reduction in DS concentrations can be expected with increasing distance from the mined area as a result of the selective retention of ions on particle surfaces (Riffenburg, 1925; Qayyum and Kemper, 1962). Thus, degradation of water quality in areas adjacent to reclaimed spoil is expected to be a slow process, and it would be centuries, if ever, before deleterious effects become significant more than a few hundered feet from reclaimed areas.

Different aquifers that had poor hydraulic connection before mining would be connected through the spoil, allowing circulation if there were head differences (water pressure differences at higher and lower points) between the aquifers; however, this effect would also tend to decrease with increasing distance from the mine. Changes in hydraulic gradients in the vicinity of the mine would be insignificant when considering the total aquifer system.

Municipal water requirements due to additional population would increase up to 2,700 acre-feet per year for the region in 1990 (see Table 2-1). This increase would not have significant impact on the entire region but could have considerable impact on Ashland, Broadus, and Gillette, since it is anticipated that these towns would have the largest population increases. The following measures are being taken to mitigate these impacts. Ashland has a relatively new water system (4 years old) that has a capacity to supply more than twice the present population. The water system of Broadus is adequate to supply the present population and some increase; however, plans are being made to develop a new well field to supply the projected increased population expected by 1990. Gillette is developing a new well field (operational June 1, 1981) with the potential to supply 10 times the current municipal use. The quality of the water from this new well field is superior to that of the existing well field and would be blended to improve the quality of the present supply.

Surface Water

The surface outflow from the region would be reduced by 350 to 700 acre-feet per year (0.05 to 0.1 percent) but the impact would be negligible. Estimates of the reduction of surface outflow from the prospective lease tracts are based on field observations and are less than the projected increases in water use because much of the water intercepted and consumed by mining would otherwise be dissipated by evapotranspiration losses on site or en route downstream. Thus, use of this water for mining would, in part, merely exchange one form of consumptive use for another. The potential depletion of surface water that might result from large-scale ground water withdrawals cannot be quantified due to lack of data. Between 20 and 33 point-watering sources would be destroyed. Although the quantity of water lost would be insignificant, the loss of point-watering sources would be a deterrent to area use by wildlife and livestock until water sources would be restored.

Surface runoff from reclaimed areas may be altered slightly owing to temporary changes in infiltration rates. The effect would be relatively minor and would be short lived because infiltration on spoils would become similar to infiltration on native rangeland as root systems develop.

Discharge from coal-spoils aquifers may contain DS concentrations that are two to three times greater than those in the adjacent undisturbed aquifers (Van Voast and Hedges, 1975). This water could be cathartic and marginal for use by livestock and wildlife. Most of the discharge from spoils aquifers would occur as small springs and seeps in ephemeral stream channels, which would delay and reduce the effect of that discharge on the quality of water in perennial streams. The possible exception would be the Tongue River which may receive spoils discharge through the clinker. The upper limit of the potential increased dissolved load of the Tongue River that would result form the leaching of mine spoils (without additional leasing of federal coal, and assuming DS concentrations of spoils discharge is twice that from undisturbed aquifers) is estimated to be about 0.5 percent. The proposed leasing and development of additional federal coal could cause the DS concentrations of the Tongue River to increase 0.4 to 0.5 percent (a cumulative increase of 0.9 to 1.0 percent) depending on the alternative selected. Because Armells Creek would have the greatest area of spoils in relation to the size of the drainage, the dissolved load of Armells Creek near Forsyth, Montana, may be increased by as much as 4 percent owing to leaching of mine spoils. However, the increase in DS concentrations in Armells Creek, the Tongue River, and other tributaries to the Yellowstone River would cause the DS concentrations of the Yellowstone River to increase by less than 0.1 percent under Alternative 1, 0.03 percent under Alternatives 2 and 3, and 0.04 percent under Alternative 4. Increases in DS concentrations would have no significant impact on current uses of water or on aquatic biology downstream.

Data show that concentrations of heavy metals in some of the spoils leachate are greater than in most of the natural surface water and exceed recommended maximum concentration for irrigation on a continuous basis, livestock use, public supply, and aquatic biota (BLM, 1979a). However, the data are not adequate to allow evaluation of potential hazards related to possible heavy metal contamination of streamflow by discharge from spoils aquifers.

Sewage effluent would increase in proportion to the quantity of municipal water used. As a result, increased salinity and harmful bacterial contamination would occur in the Tongue and North Platte rivers. The increase in DS concentrations resulting from increased sewage effluent would be about 0.5 percent in the Tongue River and 0.07 percent in the North Platte River. This would cause no significant impact to the aquatic biology downstream.

Restrictions on sediment transport from areas disturbed by mining activities (30 CFR 816.42 and 817.42) would result in reduced sediment yields from those areas. However, existing regulations do not apply to disturbances resulting indirectly from coal mining such as housing construction and related urbanization. Such off-site disturbances would cause sediment yields to double for 1 to 2 years and thereafter gradually decrease, returning to the predisturbance rate in 3 to 4 years. The decreased sediment yield from mined areas would offset increases resulting from urbanization; thus, impacts from increased erosion and sedimentation would be very local and short term.

UNAVOIDABLE ADVERSE IMPACTS

1) Removal of parts of certain aquifers would change the character of the aquifers in the mined area. Cumulative disturbance under Alternatives 2, 3, and 4 would affect a small (35,000 to 60,000 acres) part of the total area (25 million acres) and the effects would be only in the mined areas. At least 47 wells and eight small springs and possibly 100 wells and 10 springs (over Alternative 1) would be destroyed by mining; however, the wells could be replaced by deeper wells and new springs probably would eventually appear. There would be negligible effect on the regional ground water system.
2) Interruption of premining ground water flow would lower water levels in 58 to 81 wells (over Alternative 1) within a few miles of the mine, but the effect would be limited to the period of mining and would diminish with distance from the mine.
3) Modification of ground water flow by replaced spoil aquifer would eliminate perching conditions which created springs and seeps in certain areas. The effects would be limited to the area of the mine and would have negligible impact on the regional ground water system. Increased water use by the increased population resulting from mining new federal coal would cause a small lowering of ground water levels in the vicinity of municipal well fields.
4) Changes in ground water quality caused by leaching of spoil materials would increase DS concentrations in reclaimed areas possibly to two to three times the mining levels. The effects would be long term but would be largely local and the water would still be suitable for livestock.
5) Municipal use of water would increase up to 2,700 acre-feet (Alternative 4) per year. Increased consumptive use would decrease surface outflow by about 0.05 to 0.1 percent. The DS concentrations of streamflow in the region could increase by a maximum of about 4 percent, but the increase would be undetectable in the major rivers that carry water beyond the region.

SHORT TERM VS. LONG TERM

Ground water levels in the vicinity of the mines would be lowered during mining; however, they would return to near premining levels within a few years after reclamation. A short-term impact on the quality of the water is reclaimed spoil aquifer would be increased two to three times the minerialization of the original aquifers. In the long term, the water would gradually return to approximately the same quality as the average quality in the removed aquifers.

Consumptive use of water by the increased population, which is assumed to be permanent, would reduce water yield from the region by less than 0.025 or up to 0.05 percent.

IRREVERSIBLE/IRRETRIEVABLE

Removal of aquifers and other strata in the mined areas would permanently destroy 35,000 to 60,000 acres of aquifers (.002 percent of total

aquifers within the region) and alter conditions of ground water occurrence. Removal of perching layers would destroy eight to ten springs and several seeps. Forty-seven to 100 shallow wells would be permanently destroyed (Van Voast and Hedges, 1975).

Water consumed by the increased population would be irretrievable. Increased consumptive use at maximum development would be 2,700 acre-feet per year. Increased DS concentrations that result from increased sewage effluent would irreversibly increase the DS concentrations of receiving streams by as much as 0.07 percent, but water would still be suitable for all current uses.

AIR QUALITY

The direct effects from mining activities and the indirect effects of mining-related development (associated population and transportation growth) were assessed for the areas in which significant increases in concentrations above background levels are expected. These areas are the Decker area, the Colstrip area, and the Custer National Forest area and Gillette (Radian, 1981).

The significant pollutant emissions associated with the development of the proposed lease tracts and the accompanying secondary growth are TSP, NO_2, and SO_2. Impacts of emissions of the other criteria pollutants would be insignificant, and virtually unmeasurable on a regional scale (Radian, 1981). Mining activities generate significant quantities of TSP, and relatively small quantities of NO_2, SO_2, CO, NMHC, O_3, and Pb. Power plants in the affected region are significant sources of TSP, NO_2, and SO_2, while emitting smaller amounts of the other pollutants. The principal emissions from cities and towns are TSP, NO_2, and SO_2. Vehicular traffic may produce localized elevations of CO levels, but these emissions are not significant on a regional basis. Thus, the analysis of air quality will focus on the impacts on ambient levels of TSP, NO_2, and SO_2.

The models, meteorological data, receptor array, and vistas used in the air quality analyses are discussed in the Technical Report (Radian, 1981).

Characterization of the source emission is also discussed in the Technical Report (Radian, 1981). Included are the emission factors, control devices, and efficiencies. Also discussed are the major point and area sources which would be impacted by the proposed mines.

All pollutant sources must be evaluated to determine PSD applicability. Coal mines are subject to new source review for PSD only if nonfugitive emissions of any regulated pollutant exceed 250 tons per year after application of controls. Surface coal mines will seldom have the potential to exceed that level. This essentially eliminates the proposed lease tracts from the detailed PSD review process. Therefore, PSD applicability is not discussed further.

Alternative 1

Annual TSP concentrations near existing mines in Montana and near Sheridan, Wyoming, would not exceed 25 $\mu g/m^3$ (33 percent of the Montana and federal standard and 40 percent of the Wyoming standard). In the vicinity of Gillette, Wyoming predicted concentrations would not exceed 40 $\mu g/m^3$ (53 and 67 percent of the federal and Wyoming standards, respectively). Near the Caballos Rojo and Cordero Mines, the TSP levels could be as high as 50 $\mu g/m^3$ (67 and 83 percent of the federal and Wyoming standards, respectively). Total TSP levels would be about 69,300 tons per year.

Emissions from Gillette are predicted to add less than 1 $\mu g/m^3$ to the background TSP levels in 1995. The interaction of the town, the surrounding mines, and the major roads entering Gillette would contribute less than 5 $\mu g/m^3$ to the background levels of 16 $\mu g/m^3$ outside of Gillette.

Other major source contributions include major roadways such as I-90 between Gillette and Moorcroft which adds 1 $\mu g/m^3$ or less to background levels, and the Wyodak and Neil Simpson power plants which would add less than 8 $\mu g/m^3$ to the background TSP concentration.

Predicted concentrations of NO_2throughout the region would not exceed the state or federal ambient air quality standards in 1990 or 1995. Ambient concentrations in the vicinity of Gillette are predicted to be less than 48 $\mu g/m^3$ and regional impacts of emissions from the Wyodak and Neil Simpson power plants would be less than 35 $\mu g/m^3$. Roadways would contribute less than 3 $\mu g/m^3$ to the 16 $\mu g/m^3$ background level.

The interaction among all NO_2sources would produce NO_2 concentrations no greater than 40 $\mu g/m^3$. Combined with the background level of 16 $\mu g/m^3$ total ambient NO_2 concentrations would reach 56 $\mu g/m^3$ which is 56 percent of the state and federal standards.

Predicted 1990 and 1995 SO_2 concentrations throughout the region are less than 26 $\mu g/m^3$ (including the 1 $\mu g/m^3$ background level), which is 32 percent of the federal standard and 43 percent of

state standard. The highest concentrations would be in the vicinity of Neil Simpson and Wyodak power plants.

Alternative 2

Alternative 2 would not significantly increase the emissions from any town, roadway or power plant in the region. The impact of emissions from these sources would not noticeably change from Alternative 1 impacts.

The Colstrip tracts would increase TSP concentrations 5 $\mu g/m^3$ above Alternative 1 levels to 26 $\mu g/m^3$ vicinity of these mines. The interaction of the Colstrip tracts with nearby existing mine (i.e., Big Sky) is negligible.

Ashland (Coalwood) and Northwest Otter Creek would add 5 $\mu g/m^3$ near the mine boundaries to the 16 $\mu g/m^3$ background level 1 $\mu g/m^3$ about 1 mile from the mines. The interaction of these mines with existing Coal Creek Mine is negligible.

Spring Creek, North and West Decker mines would add 5 $\mu g/m^3$ to the Alternative 1 TSP levels. This would result in ambient concentrations of 26 $\mu g/m^3$ around the East, North, and West Decker mines.

Spring Draw would increase TSP concentrations 1 $\mu g/m^3$ within 1 to 2 miles of the mine. This would act to increase the area of 5 and 20 $\mu g/m^3$ total TSP concentrations over what was predicted in Alternative 1. Concentrations near the mine boundaries at Timber Creek and Duck Nest Creek would increase by 5 $\mu g/m^3$. Increases of 1 $\mu g/m^3$ would occur within 2 to 3 miles of these mines. These mines will act to increase the size of the concentration isopleths. Duck Nest Creek would interact with Belle Ayr to increase concentrations by 10 $\mu g/m^3$. Total TSP level would be about 84,700 tons per year.

The increase in nitrogen dioxide concentrations is predicted to be less than 5 $\mu g/m^3$ within the region in 1990 and 1995, resulting in ambient levels of 21 $\mu g/m^3$.

Sulfur dioxide levels are not predicted to increase more than 1 $\mu g/m^3$ above the background level of 1 $\mu g/m^3$ throughout the region in 1990 and 1995.

Alternative 3

The impacts of Alternative 3 are the same as for Alternative 2 except in the area of Spring Draw, Kintz Creek, and Keeline. Spring Draw is not included in this alternative. Kintz Creek and Keeline are predicted to add less than 5 $\mu g/m^3$ of TSP in their vicinity in 1990 and 1995. These two tracts would interact with existing mines to produce ambient concentrations of less than 26 $\mu g/m^3$. Total TSP level would be about 86,100 tons per year.

The increase in nitrogen dioxide concentrations is predicted to be less than 5 $\mu g/m^3$ within the region in 1990 and 1995 resulting in ambient levels of 21 $\mu g/m^3$.

Sulfur dioxide levels are not predicted to increase more than 1 $\mu g/m^3$ above the background level of 1 $\mu g/m^3$ throughout the region in 1990 and 1995.

Alternative 4

The impacts of the maintenance tracts in Alternative 4 are identical to those of Alternatives 2 and 3. The impact of Duck Nest Creek is identical to its impact in Alternatives 2 and 3. The impacts of Spring Draw, Kintz Creek and Keeline are identical to those of Alternatives 2 and 3.

Ashland (Decker-Birney), Ashland (Coalwood), Northwest Otter Creek, and Southwest Otter Creek all produce impacts of less than 10 $\mu g/m^3$ near the mines and 1 $\mu g/m^3$1 mile from the mines. Their interaction results in ambient concentrations of 26 $\mu g/m^3$ between the two Ashland mines and an area of 17 $\mu g/m^3$ concentrations stretching 15 miles along the north-south axis of Ashland (Coalwood) and Southwest Otter Creek and 9 miles along the east-west axis of Ashland (Decker-Birney) and Northwest Otter Creek. In this alternative, Rocky Butte and Timber Creek interact with Caballo to produce maximum ambient concentrations of approximately 46 $\mu g/m^3$. This is 77 percent of the Wyoming standard and the federal secondary standard. Total TSP level would be about 94,900 tons per year.

The increase in nitrogen dioxide concentration is predicted to be less than 5 $\mu g/m^3$ within the region in 1990 and 1995 resulting in ambient levels of 21 $\mu g/m^3$.

SO_2 levels are not predicted to increase more than 1 $\mu g/m^3$ for an ambient concentration of 2 $\mu g/m^3$ throughout the region in 1990 and 1995.

Short-term (24-hour) modeling was performed for two groups of sources near the town of Gillette. One group consisted of the town of Gillette; the Neil Simpson and Wyodak power plants; and Wyodak, East Gillette, Dry Fork, South Rawhide, Buckskin, and Eagle Butte surface coal mines; and Spring Draw tract. The other group consisted of the Rocky Butte, Timber Creek, Duck Nest Creek

tracts; and Caballo, Belle Ayr, Pronghorn, Caballos Rojo, and Cordero surface coal mines. Emissions from 1995 were modeled to determine maximum 24-hour TSP concentrations since emissions for 1990 would be less. Therefore, air quality impacts predicted for 1995 are a conservative estimate of maximum expected short-term concentrations.

Emissions from the mines and power plants north and east of Gillette produced several areas with ambient concentrations greater than 36 $\mu g/m^3$. The ambient concentrations exceed 116 $\mu g/m^3$ in several areas. Violations of the Wyoming 24-hour standard may occur north of Spring Draw, Buckskin, Rawhide, and Wyodak.

In the area southeast of Gillette, the mines interact to form several areas with concentrations exceeding 36 $\mu g/m^3$ the largest of which extends for about 11 miles north-south. Ambient concentrations greater than 116 $\mu g/m^3$ occur at several locations. Ambient concentrations in the following areas may exceed the 24-hour TSP standard in Wyoming: northeast of Rocky Butte, Belle Ayr and Duck Nest Creek, and southeast of Caballos Rojo.

The visibility impacts of the existing sources and the proposed mines would not be significant. Reduction of visual range in 1995 east of the Northern Cheyenne Indian Reservation would be about 3 percent and a decrease in apparent contrast 0.047. North of Gillette reduction of visual range would be about 7 percent for 1995 and decrease in apparent contrast 0.021. (The inherent contrast of the viewed object is assumed to equal −0.7, a typical value for a tree covered hill). Therefore, on a regional basis, the proposed alternatives would cause a minimal visibility impact. Visibility degradation may occur downwind of the largest proposed mines when meteorological conditions cause poor dispersion.

The Technical Report (Radian, 1981) contains a more detailed discussion of the above results.

UNAVOIDABLE ADVERSE IMPACTS

The coal cannot be produced by surface mining without generating fugitive dust. The impacts of individual mines decrease rapidly beyond the mine boundary. Annual ambient TSP levels would increase by 1 $\mu g/m^3$ over sizeable portions of the region. Localized violations of the short-term standards could occur if unfavorable meteorological conditions persist for several hours at a time.

SHORT TERM VS. LONG TERM

Anticipated air quality impacts would constitute a short-term use of the air resource. Insofar as the impacts may cause or contribute to violations of the federal and state ambient air quality standards (e.g., in the immediate vicinity of some existing and proposed mine clusters), or consume a portion of the PSD increment, there would be a potential restriction on the nearby development of other industrial activities that emit air pollutants. Near the mines, this impact would cease when mining activities are completed and the areas are reclaimed. Air pollutant emissions that result from the portion of the induced population that chooses to remain in the area after mining is completed may continue to consume a minor portion of the PSD increments, and thus may result in a small, localized long-term impediment to industrial siting opportunities.

IRREVERSIBLE/IRRETRIEVABLE

On a regional basis, the proposed leasing actions would irreversibly commit a relatively small portion of the air resource. Upon completion of the mining activities, reclamation of the leased properties and relocation of the population increments that result directly and indirectly from the mining activities, it would be possible to retrieve the air resource commitment and return air quality to the current conditions.

SOILS, VEGETATION, AND RECLAMATION

The difference in impacts to soils and vegetation between alternatives primarily is a function of the amount of soil disturbed. Table 4-3 shows the total acres disturbed through end of mine life. The impacts of these alternatives on the soils would be the alteration of existing soil characteristics and properties. These alterations would affect permeability, infiltration rates, soil/air and soil/water relationships, bulk density, nutrient level, micro-organism composition, and productivity, all of which have developed over a period of time.

All of the regional development activities would result in accelerated erosion by wind and water due to exposure and increased activity, until the soil is revegetated. The increased erosion would result from the disturbed soils not having any protective cover and inability of the soil to soak up water. Future population increase in the region would impact soils by a permanent loss of soil surface which results from the construction of housing and support facilities.

Reclaimed soils would not redevelop structural characteristics comparable to the original soil for decades (in the case of less developed soils) to many centuries (for the more developed soils) or not at all for Aridisols, which probably formed under a different climate. Though these lands would be reclaimed, in some cases they would require more intensive and costly management to be revegetated and stabilized. The success of reclamation and revegetation would depend on the nature of the mine site and the specifics of the mine and reclamation plan. Reclamation success for vegetation has been shown to be good so the impact of vegetation loss would not be long term (BLM, 1981; Packer, 1974).

UNAVOIDABLE ADVERSE IMPACTS

The residual impacts on soils would be the alteration of existing soil characteristics and properties. These alterations would affect permeability, infiltration rates, soil/air and soil/water relationships, bulk density, nutrient level, micro-organism composition, and productivity. Vegetation would be lost until reclamation and revegetation is completed.

SHORT TERM VS. LONG TERM

Return of a significant part of the disturbed land to a productive state during the life of the mine is anticipated. Several years after initial revegetation, vegetative productivity could vary from 50 to 100 percent of the premining level, which exhibits wide variation due to different soils and terrain.

IRREVERSIBLE/IRRETRIEVABLE

Soil loss resulting from disturbance would be considered irretrievable. The disturbance of natural soil profiles and the different associated vegetation types is irreversible.

WILDLIFE

Losses (death and relocation) to mule deer could be as high as 450 (about 4 percent of total hunt area population). Major causes for these losses would be habitat loss, and a combination of poaching, road kills, and urban development. Location of mines, access roads, and railroad spurs would disrupt local daily and seasonal movements in the Otter Creek area. Drastic topography changes in hunt areas 17 and 18 would occur due to the Thunderbird, Wildcat and Horse Creek developments. Extensive areas of ponderosa pine or juniper cover would be mined and removed for use as important thermal and escape cover.

Antelope losses (death and relocation) within the region could be as much as 2,460 animals. These losses would occur due to habitat loss, location of railroad and access roads, and increased traffic. Up to 460 animals could be lost in the Decker and Otter Creek areas alone during a severe winter due to loss of critical habitat (USGS, 1979; Martin, 1980). The Spring Creek and North Decker Mines would remove several hundred acres of critical habitat used by about 375 antelope during the severe winters of 77-78 and 78-79. This, in turn, would cause overcrowding on nearby important winter ranges. The animals would be more vulnerable to death from disease and starvation during severely cold weather and heavy snow. Losses to antelope in hunt areas 24 and 101 would be about 560 animals (8 percent of hunt area population). Animal access to hunt areas 24 and 101 would be severely restricted because of the railroad between Gillette and Orin Junction. Seasonal or daily movements would be further restricted by active mining operations and county roads crossing the railroad which would reduce the hunt areas into smaller pastures. Duck Nest Creek tract would create the greatest restriction to movement. Range overuse, possible lack of water sources, increased road kills, and crop depredation would all result from the development of this tract. The mine pit, haul roads, and stream channel diversion would cause the north-south movement corridor between the Belle Ayr Mine and Highway 59 to be about 1 mile wide at the western edge of the pit. Additional restriction of movement in the northern portion of hunt area 24 would occur with the development of Timber Creek and Rocky Butte tracts together. Development of Kintz Creek and Keeline tracts would disrupt seasonal use in the southern portion of hunt

area 24. Losses to antelope in hunt area 17 would be about 400 animals (4 percent of hunt area population). The railroad spur to Wildcat, Wildcat Creek, and Horse Creek developments would create a movement barrier to antelope in hunt area 17. Movement to favored wintering areas would further be hindered by increased traffic on Highway 14-16 and the presence of new subdivisions on the west side of the highway. Development of the Spring Draw tract in hunt area 17 would take place in an area used for staging (where animals congregate prior to movement) prior to fall migration. As mining would progress into the western third of the Spring Draw tract severe restriction of seasonal movement would occur. Contributing factors to the impact on this tract would be the presence of housing subdivisions to the west and northwest, and the Buckskin Mine access road to the south. Fall antelope movement north of Rocky Butte tract would be further hindered by new housing subdivisions.

About 13 sharp-tailed grouse leks could be affected. Four sharp-tailed grouse leks would be destroyed in the Colstrip area and nine in the Otter Creek area. Long-term population decline should not occur in the Colstrip area. As long as sufficient nesting habitat remains near the disturbed lek, the population would probably shift to undisturbed areas. If exceptions are granted on two leks overlying federal minerals in the Otter Creek area, 58 percent of the Otter Creek area population would be affected. One sage grouse lek would be destroyed in the Decker area. Within hunt area boundaries 24 and 101 two sage grouse leks would be destroyed and nesting territories for these game birds would be reduced by 20 to 50 percent.

Approximately 13 percent of the Campbell County population of golden eagles would move to new nesting locations because their nesting sites would be mined. Successful mitigation would involve establishing artificial nests or platforms within a territory being disturbed.

Table 4-4 shows wildlife habitat acreage that would be disturbed under each alternative.

UNAVOIDABLE ADVERSE IMPACTS

The short-term loss of wildlife habitat (Table 4-4). Wildlife population losses due to poaching and road kills would be unavoidable.

SHORT TERM VS. LONG TERM

On the short-term, antelope populations could be reduced by as much as 2,000 animals in Wyoming hunt areas 24 and 101 and 17; reduction in the Decker and Otter Creek areas of Montana could be up to 460 antelope. About 13 pairs of golden eagles would be manipulated into nesting away from active mining areas. Sufficient hunting habitat for these birds would exist after mining, which would allow them to reoccupy the nests they presently use. Sharp-tailed grouse population in the Colstrip and Otter Creek areas would be reduced from 15 to 48 percent during the short term due to the loss of 13 leks and adjacent nesting territories.

In the long term, antelope population would remain depressed 10 to 30 years after mining due to the long establishment time for sagebrush to invade reclaimed areas. Also, sharp-tailed grouse population would remain depressed from 10 to 20 years after mining until sufficient escape cover has regrown in reclaimed areas.

IRREVERSIBLE/IRRETRIEVABLE

Animals lost during the development of new coal mines in the region would be irretrievably lost. Loss of topographic diversity (rough topography reclaimed to gentle slopes) would support fewer deer population.

CULTURAL RESOURCES

All cultural sites will be identified on the lease tracts prior to mining. The State Historic Preservation Officers (SHPO) in Montana and Wyoming, and the advisory council will determine significance. Any site identified as potentially eligible for listing on the National Register would be protected (National Historic Preservation Act, Section 6).

Cultural resources would be committed to either destruction or data retrieval. Table 4-5 shows estimated cultural sites that could be affected by 1990. A systematic collection and analysis of information would add to the scientific knowledge of the area; however, some knowledge would be lost due to excavation of sites before improved technology is available. Also, unauthorized collection of artifacts due to population increases would result in the reduction of the integrity of the resource. Buried sites would be lost.

UNAVOIDABLE ADVERSE IMPACTS

All sites would be disturbed with mining. Some knowledge would be lost due to excavation of sites before improved technology.

SHORT TERM VS. LONG TERM

A cultural inventory for unstudied areas of the region would be performed at an earlier date with coal development taking place.

IRREVERSIBLE/IRRETRIEVABLE

Cultural resources would be disturbed. Data retrieval would not be available for future researchers. Buried cultural sites would be lost.

VISUAL RESOURCES

Coal mining would have the greatest impact on the scenic quality of the landscape than any of the other energy related activities within the region. The extraction of the coal by strip-mining changes form, line, color, and texture of the landscape. Silos, conveyors, and facility structures change line and color; access roads, railroad spurs, and power lines change line and texture.

These changes would result in a reduction of scenic quality and a change in management class. The area impacted is largely scenic quality C with some B, and VRM Class III or IV (see Appendix D). Within the region the most sensitive locations to this reduction in scenic quality would be along high-use roadways, recreation areas, and near population centers. Mines located in these areas could also provide a resource for interpretive and educational programs.

UNAVOIDABLE ADVERSE IMPACTS

Decreasing VRM Class III and IV areas to Class V through the end of mine life would be unavoidable.

SHORT TERM VS. LONG TERM

Visual contrast impacts created by access roads, railroad spurs, power lines, and facility structures would change VRM Class III and IVs to Class V on the short term.

IRREVERSIBLE/IRRETRIEVABLE

None identified.

LAND USE

Table 4-3 shows acres disturbed by mining for each alternative. Access roads, railroad spurs, and urban growth would remove an additional 11,400 acres under Alternative 1, 800 acres each for Alternatives 2 and 3, and 930 acres under Alternative 4. Underground utilities, pipelines, and overhead power lines would modify agricultural use but would not remove acres from production.

Impacts to the 44 individual farm and ranch operations would be offset by compensation and royalties to the landowner (see Appendix G).

Loss in crop production would depend upon acres of each crop planted but the acreage itself represents county decreases of .2 percent in Big Horn, .5 percent in Powder River, 1 percent in Rosebud, and 2 percent in Campbell under Alternative 2. Decreases that would occur under Alternative 3 are identical except for Powder River County, which would be 1 percent. Under Alternative 4 decreases would be .2 percent in Big Horn, 1 percent Powder River, 2 percent in Rosebud, and 4 percent in Campbell.

The loss in agricultural land use would represent a loss of 7,063 AUMs of grazing under Alternative 2; 7,558 under Alternative 3; and 11,476 under Alternative 4.

Other impacts upon land use would be relocated railroad lines and county roads.

UNAVOIDABLE ADVERSE IMPACTS

Conversion of existing rural land uses to mine-related and urban uses would be unavoidable. Loss of AUMs described above is also unavoidable.

SHORT TERM vs. LONG TERM

In the short term there would be a loss of agricultural productivity on tracts until reclamation is completed. Interruption of existing land uses would occur during construction of pipelines, power lines, and utilities. There would be a long-term loss of agricultural land use to urban growth.

IRREVERSIBLE/IRRETRIEVABLE

Lands used for urban expansion, access roads, and railroads would be irretrievable.

RECREATION

The present number of facilities would fall short by 1990. The regional population would increase from 180,000 to 239,000 (approximately 30 percent by 1990 for Alternative 1) and 434,000 (approximately 140 percent for Alternative 4). A corresponding increase in all recreational activities would occur. The greatest increases would be fishing in Montana and winter activities in Wyoming (Montana Game and Fish, 1978; Wyoming Recreation Commission, 1980). Hunting pressures would increase in Montana from 64,900 participation days to between 70,700 days for Alternative 1 (No-Action) and 77,000 days Alternative 4 (maximum leasing). In Wyoming the increase would be from 269,625 participation days to between 380,800 for Alternative 1 and 414,700 for Alternative 4.

While not quantifiable the impacts on recreation would be degradation of sites and areas from increased use and vandalism, and increases in operating and maintenance costs to federal, state, and local governments plus the private sector.

UNAVOIDABLE ADVERSE IMPACTS

Population increases from additional coal leasing would place high demand and use on existing facilities which have not increased in supply. Loss of public lands would decrease the areas available for recreation.

SHORT TERM VS. LONG TERM

The short-term effect would be increased use on a resource that is in short supply. The long-term effect would be a decrease in demand when the population levels off or decreases making recreation facility supply adequate.

IRREVERSIBLE/IRRETRIEVABLE

Access to public lands will be irreversibly lost. The aesthetic recreation experience would be irretrievably lost because of the increased number of users on existing recreation areas.

TRANSPORTATION

Railroads

Appendix F (Figure F-3) shows the estimated TPD for each alternative. These impacts are based on peak production and are shown on Table 4-6. The increased number of trains would have the most impact on communities along the main lines. In these communities, interruptions for at-grade crossings would increase the affect on traffic flow, emergency vehicles, yard operations, and noise levels within the communities (see Noise Section). The probability of car/train accidents would also increase as shown in Table 4-6.

Increased traffic along main lines would result in the need for upgrading switches and traffic control systems, additional sidings, and increased maintenance and repair. The capacity of these lines could be increased to keep up with mining production (personal communication, Peter Briggs, BN, 1981). New railroad spurs would be added to provide access to new mine facilities. These new railroad

spurs would remove additional acres from agricultural production (see Land Use section).

Highways

Increased traffic is the major impact on road and highway systems. Both the number and type of vehicles impact roads directly. Increases in the traffic along primary and secondary roads would require the need for widening and safety improvements to expand road capacity. Increase in traffic, especially heavy trucks and equipment, would cause maintenance problems such as surface deterioration, ruts, potholes, snow and trash removal, bridge replacement, and signing. Additional increases in traffic would result from increased population. This growth is not estimated to exceed 2 percent annually (personal communication, Phil Colbert, Montana State Department of Highways, 1981). The roads connecting population centers and mines would be most affected. These would be Highway 59, Highway 387, Highway 14/16, Interstate 90 and Highway 87 in Wyoming; Highway 212, FAS 566, FAS 314, FAP 92, Interstate 90, and FAP 39 in Montana.

Increased traffic and road deterioration would cause increased accident rates. Because statistical projections are not available for specific routes, impacts are not quantified.

UNAVOIDABLE ADVERSE IMPACTS

Increases in railroad and auto traffic, delays for auto traffic at grade crossings, accident rates, and road maintenance would be unavoidable.

SHORT TERM VS. LONG TERM

None are identified.

IRREVERSIBLE/IRRETRIEVABLE

Any loss of life or property in car/train accidents.

NOISE

The noise-related impacts within the 55 dBA zone would be interference of sleep and work tasks, disruption of concentration, general annoyance, and disruption of wildlife and domestic animal activities. These impacts would be most significant in areas along new railroad lines and small communities which do not presently experience large amounts of train traffic. These areas would include the proposed Tongue River Railroad and the towns of Broadus, Ashland, and Birney, Montana. For railroads, the distance to this zone has been calculated based on traffic projections. The distances given in Table 4-7 are number of feet from the track center line to the 55 dBA contour.

Because actual ADT projections have not been calculated for highway traffic, specific estimates of zones could not be made. The 55 dBA zones for most routes, however, would fall between 500 and 1,000 feet from the road center line.

SOCIOLOGY

Social Organization

Social organization in Ashland and Broadus would change considerably with new federal coal development. Newcomers would be different from long-time residents in terms of occupations, values, and interests (Massey, 1977). Influx of newcomers would be at a rapid rate (see Table 4-11). This rapid population growth would disturb the stability of these two communities by changing their structure and function. Because of these two factors, the current informal system would not be able to absorb these newcomers. Thus, newcomers would establish their own independent social networks. Interpersonal relationships would become more formal. Long-time residents may feel a loss of their "sense of community." Also, in Ashland there would be the potential for conflicts between the newcomers and the Native Americans. It is likely the Native Americans would feel their lifestyle and community (both in Ashland and on the reservation) as threatened by newcomers.

The social organization in Gillette would continue apace toward formal interpersonal relationships. Population increases would add to the process of urbanization and suburbanization.

Community Services and Facilities

The community services and facilities that would be required by 1990 are given in Table 4-8.

Housing

Table 4-9 gives the projected number of dwelling units that would be required in 1990 under each alternative.

There is planning underway for housing in the Ashland district. A subdivision has received approval for construction of 46 dwellings and an additional 96 lots (personal communication, Eldon Price, Rosebud County Planner, 1981). Also, planning for two subdivisions near Ashland, located in Powder River County, would provide for an addition of approximately 180 dwellings. The update of the Powder River County Comprehensive Plan of 1979 discusses plans for expansion within the town of Broadus including residential areas (Powder River County Director, 1981). Since Gillette has been growing at a rapid rate, housing construction is expanding concurrently.

ECONOMICS

Montana

Montana counties, schools or communities do not receive a percentage of the severance tax on mineral production from the state. However, in an effort to tie potential benefits to potential costs in the analysis of Alternatives 2, 3, and 4, additional revenues to local entities were estimated on the basis of coal production.

Big Horn County

Alternative 1 (No Action). Coal production will stimulate growth in Big Horn County even without additional federal competitive leasing. A production increase of 100 percent by 1986 would cause an equal increase in coal mining employment and a moderate increase in employment by other sectors by 1990 (Table 4-10). Population increases (Table 4-11) would result in increases in public expenditures through 1990 (Table 4-12) after which the changes would stabilize.

Alternatives 2, 3 and 4. Were it not for the slight increase in employment caused by the maintenance tract, North Decker, Big Horn County would not be affected economically by Alternatives 2, 3, or 4. Because North Decker is a component of each of Alternatives 2, 3, and 4, the economic impacts to Big Horn County would be the same under each. However, in the final analysis, a relatively insignificant increase in coal employment would not result in a notable increase in public expenditures until 1990, at which time public revenues derived from the tract would equal or slightly exceed the expenditures (Table 4-12).

Powder River County

Alternative 1 (No Action). Without additional federal competitive leasing the economy of Powder River County is expected to remain static (Table 4-12).

Alternatives 2, 3, and 4. All tracts that are expected to provide stimulus to employment, except North Decker, are located in Powder River County. However, due to the close proximity of Ashland, in adjacent Rosebud County, only 40 percent of any resulting population increase is expected to reside in Powder River County.

Even though Powder River County is expected to receive less than half of any population increase, the resulting economic impact would be significant due to the small number of residents in the county. Increases in expected public expenditures during the early phase of construction (1986) would outweigh any possible increase in revenues to the county, at that time, causing a negative fiscal impact under each of Alternatives 2, 3, and 4 (Table 4-12). By 1990, however, fiscal surpluses would occur for county schools and the community of Broadus. Powder River County would experience a fiscal surplus under Subalternative 2B or 3B.

Rosebud County

Alternative 1 (No Action). Ongoing coal development, a new power plant, and an increase in oil and gas activity would put pressure on county, community, and school resources in Rosebud County without additional federal leasing. The heaviest impacts would be realized by 1986 as public expenditures increase by about 30 percent to provide necessary services to an increasing population.

Alternatives 2, 3, and 4. Because Rosebud County, Ashland in particular, would provide residence to 60 percent of the population increase associated with any of the action alternatives, but would not be the recipient of public revenues from the coal production, a negative net fiscal balance would result under Alternatives 2, 3, or 4 (Table 4-

12). This would put added pressure on public finances as it would be occurring during a period when public expenditures are expanding due to other developments.

Ashland: It is expected that all of the additional population to Rosebud County, due to Alternatives 2, 3, or 4, would reside in the small, unincorporated community of Ashland (pop. 569 in 1980). This would severely impact the community (see Table 4-11). Subalternative 2B or 3B would increase Ashland population by about 1,200 in 1990.

Agricultural Economics: Appendix G (Tables G-1 and G-2) presents an analysis of the relative impacts to agriculture in the Montana section of the region. In terms of cost/benefit, Subalternative 2B or 3B may be the most desirable.

Wyoming

Alternative 1 (No Action). Increased coal production, oil and gas development, new power plants, synthetic fuel plants, and uranium development would all be contributing factors to what is expected to be a period of rapid growth for several counties of the Wyoming region even without additional federal coal leasing. In Campbell County the major force behind an 80 percent increase in population by 1985 (Table 4-11) would be a fivefold increase in coal production, as well as a new power plant. In Converse County a tripling of coal production and the construction of a synfuels plant would contribute to an approximate 50 percent increase in population by 1985. Increased coal production in Sheridan County is expected to be accompanied by moderate growth. Other counties would undergo steady, but less spectacular, growth as they provide services or residences for commuters to the counties of high growth. Population increases in Natrona County and the city of Casper would continue apace as Casper continues to be a trade center providing wholesale and retail outlets and services to the region.

Alternatives 2, 3, and 4. In terms of the economic impacts which would result to Wyoming counties from Alternatives 2, 3, and 4 there are only two alternatives. This occurs because the effects of Alternatives 2 and 3 are the same, leaving a comparison between either of these alternatives and Alternative 4. Predictably, the impacts of Alternative 4 would be the heaviest.

Also predictable is the impact to Campbell County under any of the alternatives. Because all tracts under consideration in the Wyoming section of the region are located in Campbell County, the largest share of employment and population increases would occur in Campbell County (Tables 4-10, 4-11). Any employment or population increases to other counties, under the action alternatives, would be due to creation of secondary employment in the retail, wholesale, and services sectors or as a result of persons employed in Campbell County, but residing in another county.

Population impacts notwithstanding, Campbell County would realize a significant net fiscal surplus as the public revenues associated with Alternatives 2, 3, or 4 exceed the expected public expenditures (Table 4-12). This is true for the school district also. However, after the higher levels of sales and use tax associated with the construction period disappear, incremental expenditures by the city of Gillette resulting under these alternatives would exceed expected revenues by about 2.5 percent of the projected 1990 no-action expenditures under Alternative 2 or 3 or by about 5 percent under Alternative 4.

As the public revenues associated with the new coal production accrue to Campbell County and none to neighboring counties, the incremental net fiscal balance in other counties would be negative as public expenditures expand to serve increased populations. The largest, negative, incremental balances would occur in Natrona County and Casper at about .5 million dollars under Alternatives 2 or 3, or about 1 million dollars under Alternative 4 in 1990. The 1 million dollar level would equal about 3 percent of projected 1990 Natrona school district expenditures.

Agricultural Economics: See Section 3 "Socioeconomics" in the Tract Profiles (BLM, 1981) on the individual tracts for a discussion about the effects of coal production on Wyoming agriculture.

UNAVOIDABLE ADVERSE IMPACTS

The following unavoidable adverse impacts are presented by alternative for the purpose of comparison. Alternative 1 impacts have been added to each of the other alternatives.

ALTERNATIVE 1

1) Removal of the coal beds and destruction of overlying strata.
2) Removal of approximately 275,000 acres of aquifers.
3) Destruction of 252 wells and 25 springs.

4) DS concentrations would increase in reclaimed areas possibly two to three times the mining levels.

5) Total TSP levels would be about 69,300 tons per year.

6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 210,000 acres.

7) Wildlife population losses due to poaching and road kills.

8) Between 1,311 and 3,733 cultural sites would be disturbed. Some knowledge would be lost due to excavation of sites before improved technology.

9) Decrease of VRM Class III and IV areas to Class V.

10) Loss of 11,400 acres for conversion of existing rural land uses to mine-related and urban uses.

11) High demand would be placed on existing recreation facilities.

12) Increases in railroad and highway traffic.

13) Increased delays for auto traffic at grade crossings.

14) Increases in road maintenance.

15) Increases in accident rates.

ALTERNATIVE 2

1) Removal of the coal beds and destruction of overlying strata.

2) Removal of approximately 310,000 acres of aquifers.

3) Destruction of 299 wells and 33 springs.

4) DS concentrations would increase in reclaimed areas possibly two to three times the mining levels.

5) Total TSP levels would be about 84,700 tons per year.

6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 267,400 acres.

7) Wildlife population losses due to poaching and road kills.

8) Between 1,882 and 4,304 cultural sites would be disturbed. Some knowledge would be lost due to excavation of sites before improved technology.

9) Decrease of VRM Class III and IV areas to Class V.

10) Loss of 1,200 acres for conversion of existing rural land uses to mine-related and urban uses.

11) High demand would be placed on existing recreation facilities.

12) Increases in railroad and highway traffic.

13) Increased delays for auto traffic at grade crossings.

14) Increases in road maintenance.

15) Increases in accident rates.

ALTERNATIVE 3

1) Removal of the coal beds and destruction of overlying strata.

2) Removal of approximately 312,000 acres of aquifers.

3) Destruction of 310 wells and 35 springs.

4) DS concentrations would increase in reclaimed areas possibly two to three times the mining levels.

5) Total TSP levels would be about 86,100 tons per year.

6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 274,000 acres.

7) Wildlife population losses due to poaching and road kills.

8) Between 1,855 and 4,277 cultural sites would be disturbed. Some knowledge would be lost due to excavation of sites before improved technology.

9) Decrease of VRM Class III and IV areas to Class V.

10) Loss of 12,200 acres for conversion of existing rural land uses to mine-related and urban uses.

11) High demand would be placed on existing recreation facilities.

12) Increases in railroad and highway traffic.

13) Increased delays for auto traffic at grade crossings.

14) Increases in road maintenance.

15) Increases in accident rates.

ALTERNATIVE 4

1) Removal of the coal beds and destruction of overlying strata.
2) Removal of approximately 335,000 acres of aquifers.
3) Destruction of 352 wells and 35 springs.
4) DS concentration would increase in reclaimed areas possibly two to three times the mining levels.
5) Total TSP levels would be about 94,900 tons per year.
6) Alteration of soil characteristics and properties, and loss of vegetative cover on approximately 293,500 acres.
7) Wildlife population losses due to poaching and road kills.
8) Between 2,148 and 4,570 cultural sites would be distubed. Some knowledge would be lost due to excavation of sites before improved technology.
9) Decrease of VRM Class III and IV areas to Class V.
10) Loss of 12,330 acres for conversion of existing rural land uses to mine-related and urban uses.
11) High demand would be placed on existing recreation facilities.
12) Increases in railroad and highway traffic.
13) Increased delays for auto traffic at grade crossings.
14) Increases in road maintenance.
15) Increases in accident rates.

SHORT TERM VS. LONG TERM

The following lists of relationships between short-term uses of man's environment and the maintenance and enhancement of long-term productivity have also been presented by alternative.

ALTERNATIVE 1

1) Short-term impact of an increase in DS concentrations in reclaimed areas.
2) Ground water levels in the vicinity of the mines would be lower during the short term but would return to near premining levels after reclamation.
3) Anticipated air quality impacts would constitute a short-term use of the air resource near the mines which could place a potential restriction on the nearby development of other industrial activities that emit air pollutants.

ALTERNATIVES 2, 3, AND 4

1) Short-term impact of an increase of DS concentrations in reclaimed areas.
2) Ground water levels in the vicinity of the mines would be lower during the short term but would return to near premining levels after reclamation.
3) Anticipated air quality impacts would constitute a short-term use of the air resource near the mines which could place a potential restriction on the nearby development of other industrial activities that emit air pollutants.
4) Return of a significant part of the disturbed land to a productive state during the short term is anticipated.
5) Long-term productivity would be lowered for wildlife until sagebrush is re-established.
6) A cultural inventory of the unstudied areas of the region would be performed at an earlier date.
7) Short-term loss of agricultural productivity on the tracts until reclamation.

IRREVERSIBLE/IRRETRIEVABLE

The following types of irreversible or irretrievable commitments of resources would be the same under each alternative; differences between alternatives would be magnitude.

1) Coal once mined and consumed would be irreversible. Coal not mined due to lack of technology would be economically irretrievable.
2) Removal of aquifers and other strata in the mined areas would alter conditions of ground water occurrence.
2) Removal of perching layers would destroy springs and seeps.
3) Wells would be permanently destroyed.

4) Municipal water consumed by the additional population would be irretrievable.

6) Any soil loss resulting from disturbance would be irretrievable.

7) Disturbance of natural soil profiles and different associated vegetation types is irreversible.

8) Wildlife lost would be irretrievable.

9) Loss of topographic diversity would support fewer deer population.

10) Disturbance to cultural resources would be irreversible. Data retrieval would not be available to future researchers. Buried sites would be lost.

11) Land used for urban expansion and mine-related uses would be irretrievable.

12) The aesthetic recreation experience would be irretrievably lost.

13) Loss of life or property is irretrievable.

TABLE 4-1a
ANNUAL COAL PRODUCTION - 1990 (MILLION TONS)
(Federal, State and Private Coal)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Existing Mines	194.43	194.43	194.43	194.43
Proposed Mines	128.9	181.00	181.60	330.50
PRLAs	45.55	45.55	45.55	45.55
Total	368.88	420.98	421.58	470.48

TABLE 4-1b
ANNUAL COAL PRODUCTION - 1990 (MILLION TONS)
(Federal Recoverable Reserves Only)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Existing Mines	194.43	194.43	194.43	194.43
Proposed Mines	128.90	166.70	169.20	201.90
PRLAs	45.55	45.55	45.55	45.55
Total	368.88	406.68	409.18	441.88

TABLE 4-2
ESTIMATED MAXIMUM POTENTIAL EFFECTS ON DISCHARGE AND DISSOLVED-SOLIDS CONCENTRATIONS OF STREAMS

	Percent reduction in flow				Percent increase in dissolved-solids concentration			
	Alternative				Alternative			
	#1	#2	#3	#4	#1	#2	#3	#4
Armells Creek	1.8	a/	a/	a/	1.2	4.0	4.0	4.0
Rosebud Creek	1.0	a/	a/	a/	1.8	0.1	0.1	0.1
Tongue River	0.4	0.07	0.07	0.1	0.5	0.4	0.4	0.5
Otter Creek	0.01	1.3	1.3	2.7	0.02	1.2	1.2	2.5
Powder River	0.1	a/	a/	a/	0.3	a/	a/	a/
Little Powder River	2.8	0.2	a/	0.2	4.0	0.2	a/	0.2
Cheyenne River	0.7	a/	0.1	0.1	1.5	a/	0.1	0.1
Belle Fourche River	3.5	0.4	0.6	0.7	5.0	0.4	0.6	0.7
North Platte River	0.7	a/	a/	a/	0.07	a/	a/	a/
Yellowstone River	0.3	0.003	0.003	0.006	0.09	0.03	0.03	0.04

a/ No additional effect.

TABLE 4-3
TOTAL ACRES DISTURBED/VEGETATION TYPES AND LAND USE a/

		RANGELAND			AGRICULTURE		
ALTERNATIVE	TOTAL	SAGE/GRASS	GRASSLAND	PONDEROSA PINE	NON-IRRIGATED	IRRIGATED	MISC. b/
1	210,000	c/					
2	267,400	23,800	16,900	8,100	5,300	900	2,400
3	274,200	29,800	17,200	8,100	5,800	900	2,400
4	293,500	39,800	21,100	10,100	8,800	1,300	2,400

a/ Acres derived from total acres of each tract based on habitat types generated by U.S. Fish and Wildlife Service, WELUT, 1980.
b/ One or more of the following types: riparian, closed sage, mixed shrub, ranch yards, roads.
c/ Data breakdown of the total acreage is not available.

TABLE 4-4
CUMULATIVE ACRES OF WILDLIFE HABITAT DISTURBED BY 1990

Location	Alternative 1	Alternative 2	Alternative 3	Alternative 4
MONTANA				
Colstrip Area	3,564	5,088	5,088	5,088
Decker Area	6,890	6,890	6,890	6,890
Otter Creek	0	2,057	2,902	3,862
WYOMING				
Hunt Areas:				
Antelope 24 & 101 (Deer 21)	61,420	62,894	63,831	64,834
Antelope 17, 18, & 19 (Deer 17 & 18)	95,631	97,066	96,243	97,199
Antelope 23 (Deer 19 & 20)	57,400	57,454	57,544	57,544

TABLE 4-5
ESTIMATED AFFECTED CULTURAL SITES
1990

Alternative 1	1,311 to 3,733
Alternative 2	1,882 to 4,304
Alternative 3	1,855 to 4,277
Alternative 4	2,148 to 4,570

a/ Using known and predicted site density figures.

TABLE 4-6
AVERAGE TRAINS PER DAY AND AT-GRADE CROSSING EFFECTS

Location	Trains Per day	At-Grade Crossings Daily Interruptions 5 mph	20 mph	Car/Train Accidents [a] Per 100 Years
Alternative 1				
Miles City, MT	29	5 hrs 48 min	1 hr 27 min	3
Gillette, WY	20	4 hrs	1 hr	2
Newcastle, WY	79	15 hrs 48 min	3 hrs 57 min	10
Torrington, WY	75	15 hrs	3 hrs 45 min	9
Alternative 2				
Miles City, MT	49	9 hrs 48 min	2 hrs 27 min	6
Gillette, WY	21	4 hrs 12 min	1 hr 3 min	2
Newcastle, WY	99	19 hrs 48 min	4 hrs 57 min	12
Torrington, WY	86	17 hrs 12 min	4 hrs 13 min	11
Alternative 3				
Miles City, MT	49	9 hrs 48 min	2 hrs 27 min	6
Gillette, WY	21	4 hrs 12 min	1 hr 3 min	2
Newcastle, WY	99	19 hrs 48 min	4 hrs 57 min	12
Torrington, WY	94	18 hrs 48 min	4 hrs 42 min	12
Alternative 4				
Miles City, MT	60	12 hrs	3 hrs	7
Gillette, WY	22	4 hrs 24 min	1 hr 6 min	3
Newcastle, WY	100	20 hrs	5 hrs	12
Torrington, WY	102	20 hrs 24 min	5 hrs 6 min	13

[a] Based on 1,000 vehicles daily.

TABLE 4-7
RAILROAD NOISE CONTOUR ZONES
(NUMBER OF FEET FROM TRACT CENTER LINE)

Location	Alternative 1	Alternatives 1 & 2	Alternative 4
Miles City, Montana (Northern Route)	4,640	6,130	7,536
Gillette, Wyoming (Central Route)	3,981	3,981	3,981
Newcastle, Wyoming (Central Route)	8,580	10,000	11,659
Torrington, Wyoming (Southern Route)	8,580	10,000	11,659

TABLE 4-8
COMMUNITY SERVICE AND FACILITY REQUIREMENTS (1990) a/

Service/Facility	Montana								Wyoming							
	Rosebud				Powder River				Campbell				Natrona			
	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4	Alt 1	Alt 2	Alt 3	Alt 4
Law Enforcement (sworn officers)	21	23	23	26	4	6	6	7	105	110	110	115	150	152	152	153
Teachers	221	248	248	276	65	96	96	125	707	743	743	779	906	917	917	928
Physicians	4	5	5	5	1	1	1	2	32	33	33	35	116	117	117	119
Dentists	6	7	7	7	1	2	2	2	9	10	10	10	46	46	46	47
Hospital Beds	39	43	43	48	10	15	15	19	58	61	61	64	340	344	344	348

a/ Estimates derived from ratios given in sources below.

Source: Rosebud County Plan, 1979
Powder River Comprehensive Plan (draft), 1981.
Department of Economic Planning and Development, 1979-80.
Wyoming Department of Education, 1979-80.

TABLE 4-9
PROJECTED NUMBER OF DWELLING UNITS REQUIRED IN THE
POWDER RIVER REGION IN 1990

Montana a/	Alternative 1 Baseline	Alternatives 2 or 3 Increment	Alternatives 2 or 3 Total	Alternative 4 Increment	Alternative 4 Total
Big Horn County	5,200	100	5,300	100	5,300
Hardin	1,800	0	1,800	0	1,800
Powder River County	1,150	500	1,650	1,000	2,150
Broadus	350	280	630	800	1,150
Rosebud County	5,600	750	6,350	1,500	7,100
Ashland District	350	750	1,100	1,500	1,850
Wyoming b/					
Campbell County	17,600	900	18,500	1,800	19,400
Gillette	9,000	460	9,460	900	9,900
Converse County	8,200	75	8,275	150	8,350
Douglas	3,600	35	3,635	70	3,670
Crook County	2,900	30	2,930	60	2,960
Moorcroft	510	10	520	15	525
Johnson County	3,700	40	3,740	80	3,780
Buffalo	2,050	20	2,070	40	2,090
Natrona Country	33,200	420	33,620	810	34,010
Casper	23,500	290	23,790	570	24,070
Sheridan County	14,600	170	14,770	340	14,940
Sheridan	8,800	100	8,900	200	9,000
Weston County	3,500	30	3,530	70	3,570
Newcastle	1,750	15	1,765	30	1,780

a/ Estimates based on 1980 population to housing ratio derived from 1980 final census and housing count.

b/ Estimates based on the 1980 population to housing ratio derived from 1980 preliminary census and housing count.

TABLE 4-10
PROJECTED EMPLOYMENT FOR THE POWDER RIVER REGION IN 1990

Montana a/	Alternative 1 Baseline	Alternatives 2 or 3 Increment	Alternatives 2 or 3 Total	Alternative 4 Increment	Alternative 4 Total
Big Horn County					
Coal Employment	1,900	80	1,980	80	1,980
All Other Employment	5,600	80	5,680	80	5,680
Total	7,500	160	7,660	160	7,660
Powder River County					
Coal Employment	15	690	705	1,380	1,395
All Other Employment	1,230	690	1,920	1,380	2,610
Total	1,245	1,380	2,625	2,760	4,005
Rosebud County					
Coal Employment	1,300	0	1,300	0	1,300
All Other Employment	6,100	0	6,100	0	6,100
Total	7,400	0	7,400	0	7,400
Wyoming b/					
Campbell County					
Coal Employment	9,200	1,010	10,200	2,000	11,200
All Other Employment	14,300	180	14,480	300	14,600
Total	23,500	1,190	24,680	2,300	25,800
Converse County					
Coal Employment	1,700	0	1,700	0	1,700
All Other Employment	7,200	80	7,280	170	7,370
Total	8,900	80	8,980	170	9,070
Crook County					
Coal Employment	0	0	0	0	0
All Other Employment	1,750	20	1,770	30	1,780
Total	1,750	20	1,770	30	1,780
Johnson County					
Coal Employment	0	0	0	0	0
All Other Employment	2,600	30	2,630	60	2,660
Total	2,600	30	2,630	60	2,660
Natrona Country					
Coal Employment	0	0	0	0	0
All Other Employment	43,300	540	43,840	1,100	44,400
Total	43,300	540	43,840	1,100	44,400
Sheridan County					
Coal Employment	1,400	0	1,400	0	1,400
All Other Employment	9,500	130	9,630	250	9,750
Total	10,900	130	11,030	250	11,150
Weston County					
Coal Employment	0	0	0	0	0
All Other Employment	2,900	30	2,930	50	50
Total	2,900	30	2,930	50	2,950

a/ Baseline coal employment estimates for the Montana counties were extrapolated from the Wyoming Powder River Input-Output model based on projected additional coal production. Estimates of additional coal employment under Alternatives 2, 3, and 4 were made by Keith Bennett in Tract Profiles, Miles City District Office (BLM, 1981). All secondary employment for Montana was estimated on the basis of one additional job for each permanent primary job and .5 additional jobs for each temporary primary job.

b/ All Wyoming employment estimates were generated by the Wyoming Powder River Input-Output model developed by John McKean at Colorado State University.

TABLE 4-11
PROJECTED POPULATION IN THE POWDER RIVER REGION IN 1990

	Alternative 1	Alternatives 2 or 3		Alternative 4	
Montana a/	Baseline	Increment	Total	Increment	Total
Big Horn County	14,800	320	15,120	320	15,120
Hardin	4,400	0	4,400	0	4,400
Powder River County	2,523	1,120	3,643	2,200	4,723
Broadus	715	580	1,295	1,660	2,375
Rosebud County	14,700	1,680	16,380	3,400	18,100
Forsyth	3,800	0	3,800	0	3,800
Ashland District	800	1,680	2,480	3,400	4,200
Wyoming b/					
Campbell County	45,100	2,300	47,400	4,500	49,600
Gillette	22,500	1,150	23,650	2,250	24,750
Converse County	21,400	200	21,600	400	21,800
Douglas	9,200	90	9,290	170	9,370
Crook County	6,400	70	6,470	130	6,530
Moorcroft	1,220	15	1,235	30	1,250
Johnson County	8,300	90	8,390	180	8,480
Buffalo	4,700	50	4,750	100	4,800
Natrona Country	84,000	1,050	85,050	2,050	86,050
Casper	59,500	740	60,240	1,450	60,950
Sheridan County	33,600	400	34,000	770	34,370
Sheridan	20,300	240	20,540	470	20,770
Weston County	8,600	80	8,680	160	8,760
Newcastle	4,300	40	4,340	80	4,380

a/ Montana county estimates are based on the 1980 ratio of population to employment for permanent employment and 1.3 population to transient employment. Projections of community populations are based on the 1980 ratio of community to county.

b/ Wyoming county estimates are based on the 1980 ratio of population to employment for permanent employment and the ratio of 1970-1980 population change to the 1970-1980 employment change for transient employment. Projections of community populations are based on the 1980 ratio of community to county.

TABLE 4-12
COUNTY, SCHOOL, AND COMMUNITY BUDGET
LEVELS PROJECTED FOR 1990
(Rounded to the Nearest $100,000, Includes Debt Servicing)

Montana	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
Big Horn County					
Revenues	8,200	200	8,400	200	8,400
Expenditures	8,200	200	8,400	200	8,400
Balance	0	0	0	0	0
Big Horn County Schools					
Revenues	13,300	400	13,700	400	13,700
Expenditures	13,300	300	13,600	300	13,600
Balance	0	100	100	100	100
Hardin					
Revenues	1,000	0	1,000	0	1,000
Expenditures	1,000	0	1,000	0	1,000
Balance	0	0	0	0	0
Powder River County					
Revenues	3,800	1,400	5,200	2,500	6,300
Expenditures	3,800	1,700	5,500	3,400	7,200
Balance	0	-300	-300	-900	-900
Powder River Co. Schools					
Revenues	2,000	4,100	6,100	5,600	7,600
Expenditures	2,000	900	2,900	1,700	3,700
Balance	0	3,200	3,200	3,900	3,900
Broadus					
Revenues	200	200	400	300	500
Expenditures	200	100	300	400	600
Balance	0	100	100	-100	-100
Rosebud County					
Revenues	9,800	0	9,800	0	9,800
Expenditures	9,800	1,100	10,900	2,300	12,100
Balance	0	-1,100	-1,100	-2,300	-2,300
Rosebud County Schools					
Revenues	9,100	0	9,100	0	9,100
Expenditures	9,100	1,000	10,100	2,100	11,200
Balance	0	-1,000	-1,000	-2,100	-2,100
Forsyth					
Revenues	2,000	0	2,000	0	2,000
Expenditures	2,000	0	2,000	0	2,000
Balance	0	0	0	0	0

TABLE 4-12 continued

Montana	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
Ashland c/					
Revenues	---	---	---	---	---
Expenditures	---	---	---	---	---
Balance	---	---	---	---	---
Wyoming					
Campbell County					
Revenues	26,600	5,700	32,300	11,300	37,900
Expenditures	26,000	1,400	28,000	2,700	29,300
Balance	0	4,300	4,300	8,600	8,600
School District #1					
Revenues	69,800	10,300	80,100	20,400	90,200
Expenditures	69,800	3,600	73,400	7,000	76,800
Balance	0	6,700	6,700	13,400	13,400
Gillette					
Revenues	19,800	500	20,300	1,000	20,800
Expenditures	19,800	1,000	20,800	2,000	21,800
Balance	0	-500	-500	-1,000	-1,000
Converse County					
Revenues	13,500	0	13,500	0	13,500
Expenditures	13,500	100	13,600	300	13,800
Balance	0	-100	-100	-300	-300
School District #1					
Revenues	24,800	0	24,800	0	24,800
Expenditures	24,800	200	25,000	500	25,300
Balance	0	-200	-200	-500	-500
Douglas					
Revenues	10,800	0	10,800	0	10,800
Expenditures	10,800	100	10,900	200	11,000
Balance	0	-100	-100	-200	-200
Crook County					
Revenues	4,300	0	4,300	0	4,300
Expenditures	4,300	0	4,300	100	4,400
Balance	0	0	0	-100	-100

TABLE 4-12 continued

Wyoming	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
School District #1					
Revenues	5,600	0	5,600	0	5,600
Expenditures	5,600	100	5,700	100	5,700
Balance	0	-100	-100	-100	-100
Moorcroft					
Revenues	500	0	500	0	500
Expenditures	500	0	500	0	500
Balance	0	0	0	0	0
Johnson County					
Revenues	2,600	0	2,600	0	2,600
Expenditures	2,600	0	2,600	100	2,700
Balance	0	0	0	-100	-100
School District #1					
Revenues	7,100	0	7,100	0	7,100
Expenditures	7,100	100	7,200	200	7,300
Balance	0	-100	-100	-200	-200
Buffalo					
Revenues	2,400	0	2,400	0	2,400
Expenditures	2,400	0	2,400	100	2,500
Balance	0	0	0	-100	-100
Natrona County					
Revenues	43,000	0	43,000	0	43,000
Expenditures	43,000	500	43,500	1,100	44,100
Balance	0	-500	-500	-1,100	-1,100
School District #1					
Revenues	37,300	0	37,300	0	37,300
Expenditures	37,300	500	37,800	900	38,200
Balance	0	-500	-500	-900	-900
Casper					
Revenues	50,400	0	50,400	0	50,400
Expenditures	50,400	600	51,000	1,200	51,600
Balance	0	-600	-600	-1,200	-1,200
Sheridan County					
Revenues	20,400	0	20,400	0	20,400
Expenditures	20,400	200	20,600	500	20,900
Balance	0	-200	-200	-500	-500

TABLE 4-12 concluded

Wyoming	Alternative 1 Baseline a/ ($1,000)	Alternatives 2 or 3 Increment b/ ($1,000)	Alternatives 2 or 3 Total ($1,000)	Alternative 4 Increment b/ ($1,000)	Alternative 4 Total ($1,000)
School District #2					
Revenues	13,700	0	13,700	0	13,700
Expenditures	13,700	200	13,900	300	14,000
Balance	0	-200	-200	-300	-300
Sheridan					
Revenues	9,900	0	9,900	0	9,900
Expenditures	9,900	100	10,000	200	10,100
Balance	0	-100	-100	-200	-200
Weston County					
Revenues	4,700	0	4,700	0	4,700
Expenditures	4,700	0	4,700	100	4,800
Balance	0	0	0	-100	-100
School District #1					
Revenues	4,500	0	4,500	0	4,500
Expenditures	4,500	0	4,500	100	4,600
Balance	0	0	0	-100	-100
Newcastle					
Revenues	2,000	0	2,000	0	2,000
Expenditures	2,000	0	2,000	0	2,000
Balance	0	0	0	0	0

a/ These are the budget levels that are expected to exist without additional Federal Competitive Leasing. Expenditures were projected from actual FY 1979/1980 budgets (including debt servicing) on a per capita basis in order to maintain the per capita spending levels of FY 1979/1980. It is assumed that revenues will equal expenditures.

b/ The additional expenditures above baseline expenditures, which are required to maintain FY 1979/1980 per capita spending levels for additional populations, were projected from actual FY 1979/1980 budgets (including debt servicing) on a per capita basis. Additional revenues above baseline revenues for Montana Counties are based on revenue to coal production ratios derived from a baseline run of the coal town model, which was generated by Keith Bennett. Additional revenues for Wyoming Counties were generated by a coal revenue model developed by Thomas F. Stinson at the University of Minnesota.

c/ Because Ashland is an unincorporated community without a formal budget it is difficult to make reliable budget projections.

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APPENDIX A

AIR QUALITY

TABLE A-1

FEDERAL, MONTANA, AND WYOMING MAXIMUM ALLOWABLE INCREASES (INCREMENTS)

FOR THE PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY

Pollutant	Averaging Time	Maximum Allowable Air Quality Increases (Ug/m^3) Class I	Class II	Class III
Sulfur Dioxide (SO_2)	Annual Mean	2	20	40
	24-Hour a/	5	91	182
	3-Hour a/	25	512	700
Total Suspended Particulates (TSP)	Annual Mean	5	19	37
	24-Hour a/	10	37	75

a/ The increments for these averaging times are not to be exceeded more than once per year.

TABLE A-2
NATIONAL AND STATE AMBIENT AIR QUALITY STANDARDS

Pollutant	Average Time a/	Standards							
		Federal b/ Primary		Federal c/ Secondary		Montana State		Wyoming State	
		(ug/m^3)	(ppm)	(ug/m^3)	(ppm)	(ug/m^3)	(ppm)	(ug/m^3)	(ppm)
Total Suspended Particulate (TSP)	Annual Geometric Mean	75	-	60	-	75	-	60	-
	24-Hour	260	-	150	-	200	-	150	-
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	80	0.03	-	-	60	0.02	60	0.02
	24-Hour	365	0.14	-	-	260 d/	0.10 d/	260	-
	3-Hour	-	-	1,300	0.5	650 e/	0.25 e/	1,300	0.5
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	100	0.05	100	0.05	-	-	100	0.05
Carbon Monoxide (CO)	8-Hour	10,000	9.0	10,000	9.0	-	-	10,000	9.0
	1-Hour	40,000	35.0	40,000	35.0	-	-	40,000	35.0
Non-Methane Hydrocarbons f/ (NMHC)	3-Hour (6 a.m.-9 a.m.)	160	0.24	160	0.24	-	-	160	0.24
Ozone (O_3)	1-Hour	235	0.12	-	-	-	-	235	0.12
Lead (Pb)	3-Month	1.5	-	1.5	-	-	-	-	-

a/ Standards for averaging times other than annual or 3-month are not to be exceeded more than once per year.
b/ Levels deemed necessary to protect public health with an adequate margin of safety.
c/ Levels deemed necessary to protect public welfare from any known or anticipated adverse effects.
d/ Not to be exceeded more than one percent of the days in a 3-month period.
e/ Not to be exceeded for more than one hour in any four consecutive days.
f/ For use as guide in achieving ozone standards.

APPENDIX B

WILDLIFE

FIGURE B-1

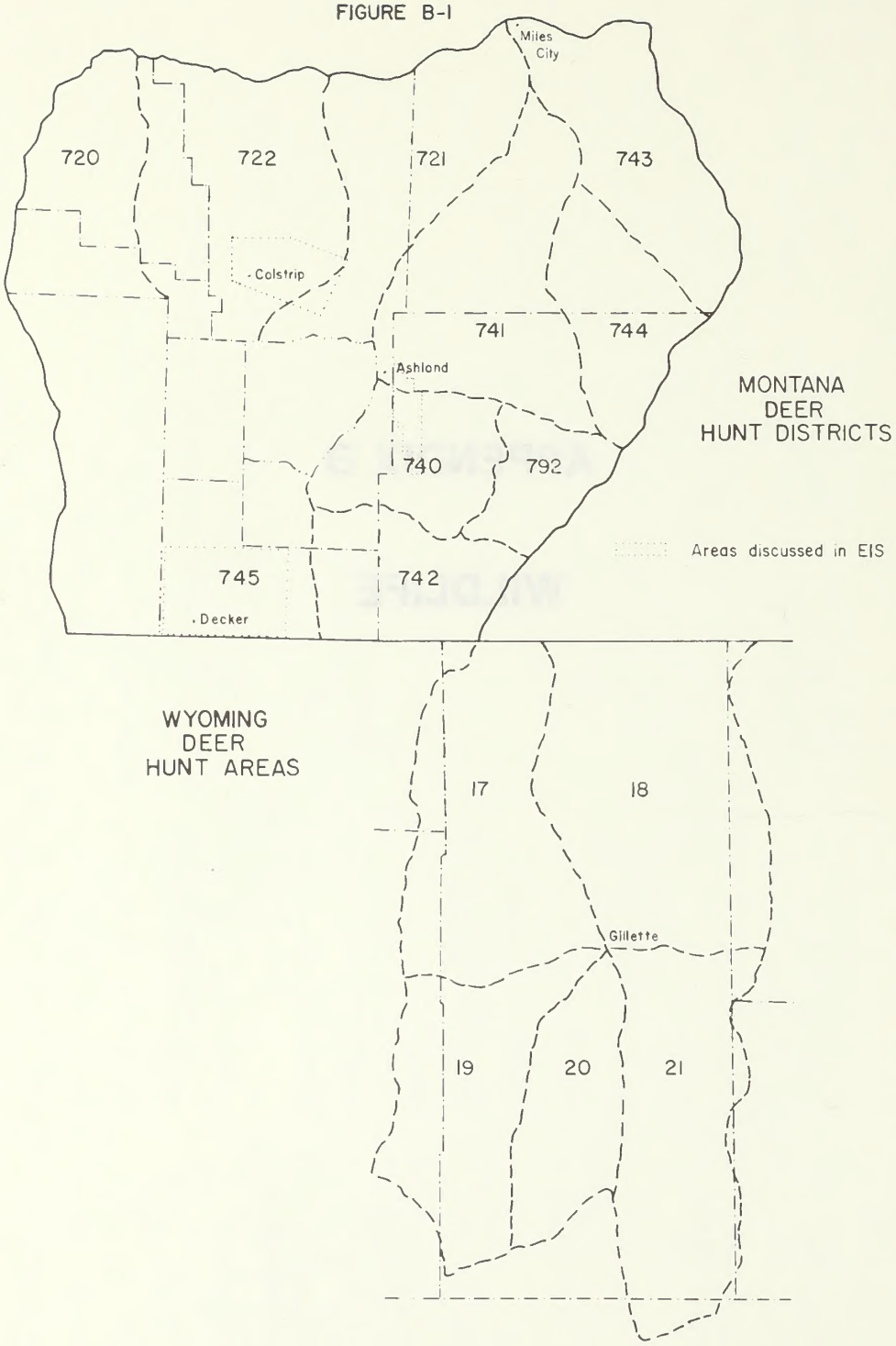
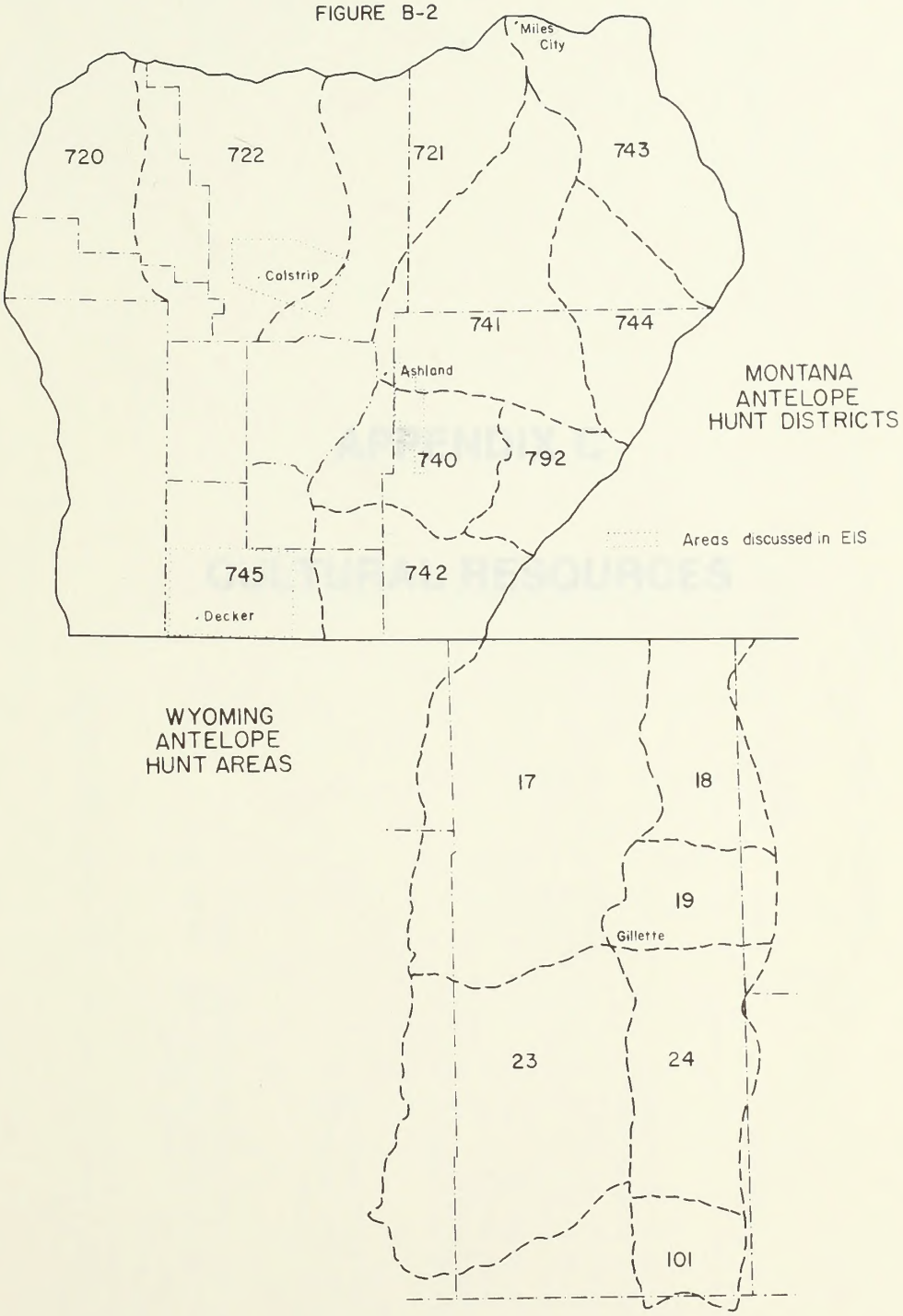

Miles City
720
722
721
743
Colstrip
741
744
Ashlond
740
792
745
742
Decker
MONTANA
DEER
HUNT DISTRICTS
Areas discussed in EIS
WYOMING
DEER
HUNT AREAS
17
18
Gillette
19
20
21

FIGURE B-2


Miles City
720
722
721
743
Colstrip
741
744
Ashland
740
792
745
742
Decker
MONTANA
ANTELOPE
HUNT DISTRICTS
Areas discussed in EIS
WYOMING
ANTELOPE
HUNT AREAS
17
18
19
Gillette
23
24
101

APPENDIX C

CULTURAL RESOURCES

TABLE C-1
IDENTIFIED CULTURAL SITES FOR THE POWDER RIVER REGION

Location	Acres	Sites Located	Average Density (Mi^2)	Historic Sites	
				On Nat'l Reg.	Recommended for Nat'l Reg.
Montana					
Otter Creek Drainage a/	9,000	120	8.5		
Pumpkin, Broadus and Foster Creeks b/	5,800	59	6.5		
Birney Area b/	9,000	98	7		
Colstrip Area c/	2,525	86	26.5		
Spring Creek d/	3,770	47	7.5		
Big Horn County				5	18
Rosebud County				1	9
Powder River County					3
Wyoming					
Rawhide Mine Lease e/			16.5		
Caballo Mine Lease f/			10		
Campbell County			2 g/		1

a/ Bryant, Gehr and Rollefson, 1980.
b/ BLM, unpublished manuscript, Clark, n.d.
c/ Munson and Munson, 1980.
d/ Fox, 1978.
e/ Anderson, 1980.
f/ Personal communication, Mary Feathers, OSM, 1981.
g/ Reher, 1979.

APPENDIX D

VISUAL RESOURCES

Scenic quality classes are defined by a system rating seven key factors - landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modification. There are three scenic quality classes:

Class A - Areas that combine the most outstanding characteristics of each rating factor.

Class B - Areas in which there is a combination of some outstanding features and some which are fairly common to the physiographic region.

Class C - Areas in which the features are fairly common to the physiographic region.

Management classes determine the amount of modification allowed to the basic elements of the landscape. There are five classes:

Class 1 - Very limited management activity is allowed. Created contrasts must not attract attention. This classification applies to wilderness areas, wild and scenic rivers, etc.

Class 1I - Changes in any of the basic elements caused by management activity should not be evident in the characteristic landscape. Contrasts are seen but must not attract attention.

Class 1I1 - Contrasts to the basic elements caused by a management activity are evident, but should remain subordinate to the existing landscape.

Class IV - Any contrast attracts attention and is a dominant feature of the landscape in terms of scale, but it should repeat the form, line, color, and texture of the characteristic landscape.

Class V - This classification is applied to areas where the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the four other classifications. The classification also applies to areas where there is potential to increase the landscape's visual quality. It is often used as an interim classification until objectives of another class can be reached.

APPENDIX E

RECREATION

TABLE E-1
HUNTING STATISTICS FOR THE POWDER RIVER REGION

Montana

	Deer Licenses	Harvest	Rec. Days	Antelope Licenses	Harvest	Rec. Days	Bighorn Licenses	Sheep Harvest	Rec. Days
1971-74 Average	44,200	34,600	169,000	11,650	8,500	35,000	2	1	20
1975	48,900	13,200	194,000	10,570	7,850	31,700	2	2	16
1976	15,766	8,961	69,502	8,488	6,307	25,464	2	1	10

	Game Bird Hunters	Harvest	Rec. Days	Small Game Hunters	Harvest	Rec. Days	Waterfowl Hunters	Harvest	Rec. Days
1970-74 Average	36,916	72,416	---	No Data			No Data		
1975	45,744	81,544	66,663	No Data			No Data		

Wyoming

	Deer Hunters	Harvest	Rec. Days	Antelope Hunters	Harvest	Rec. Days	Elk Hunters	Harvest	Rec. Days
1977	52,607	35,829	145,165	31,416	29,526	70,275	9,585	2,423	42,203
1978	49,260	27,679	130,344	29,097	27,293	68,502	10,211	1,738	48,287
1979	49,224	23,692	140,803	22,995	20,899	60,678	11,006	2,352	49,466

	Game Bird Hunters	Harvest	Rec. Days	Small Game Hunters	Harvest	Rec. Days	Waterfowl Hunters	Harvest	Rec. Days
1977	12,272	48,037	35,742	4,451	43,571	19,426	3,371	16,152	15,684
1978	10,641	38,680	30,245	5,064	47,194	21,542	3,292	16,082	15,635
1979	11,081	42,567	31,460	3,870	22,626	17,232	3,338	17,502	16,247

Sources: Wyoming Game and Fish Annual Reports, 177a,b; 1978a,b; 1979a,b.
Montana Fish and Game, 1978.

APPENDIX F

TRANSPORTATION

FIGURE F-1

MONTANA HIGHWAY SYSTEM AND

AVERAGE DAILY TRAFFIC (ADT) 1979

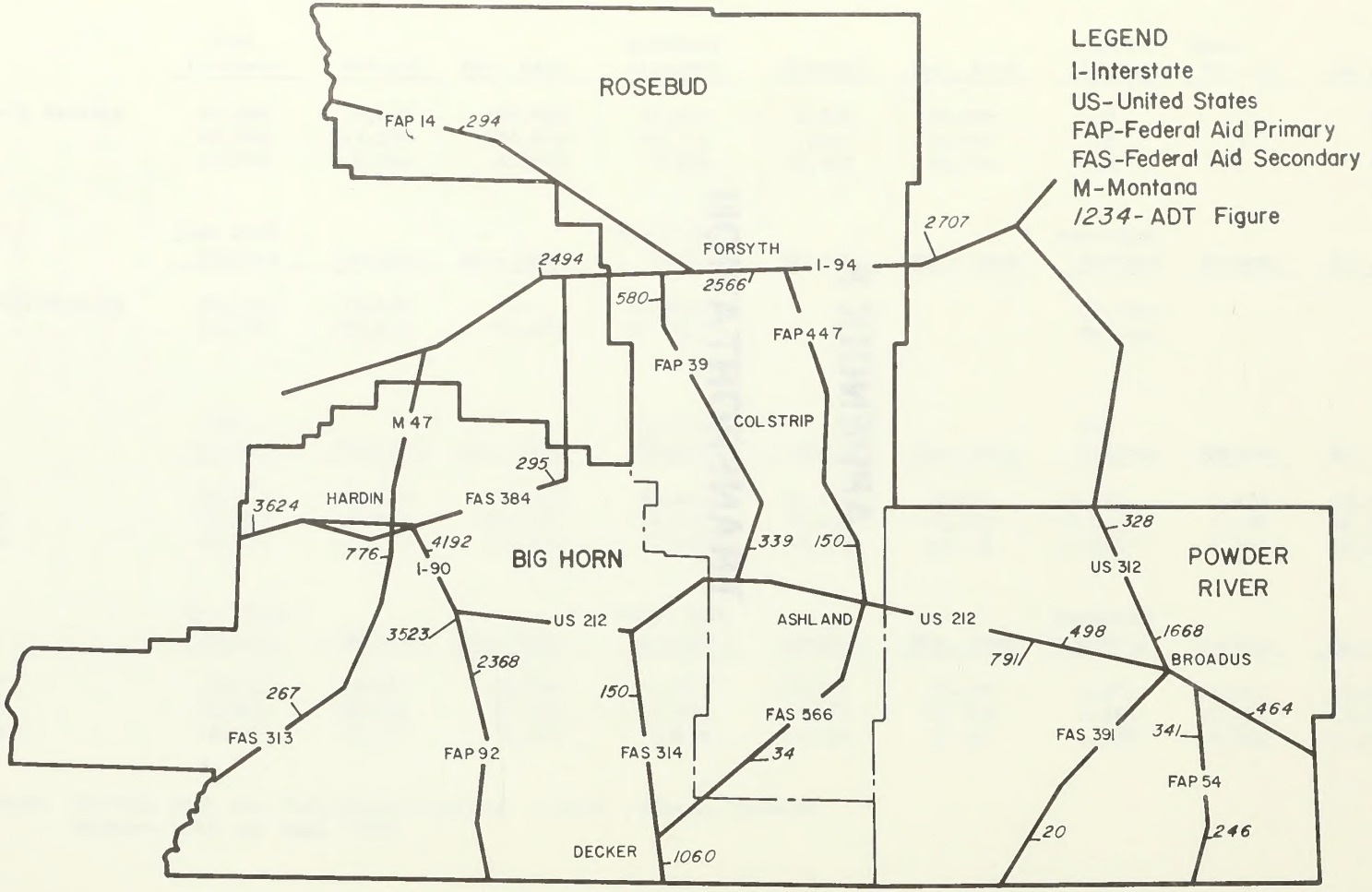


FIGURE F-2

WYOMING HIGHWAY SYSTEM

AND AVERAGE DAILY TRAFFIC (ADT) 1978

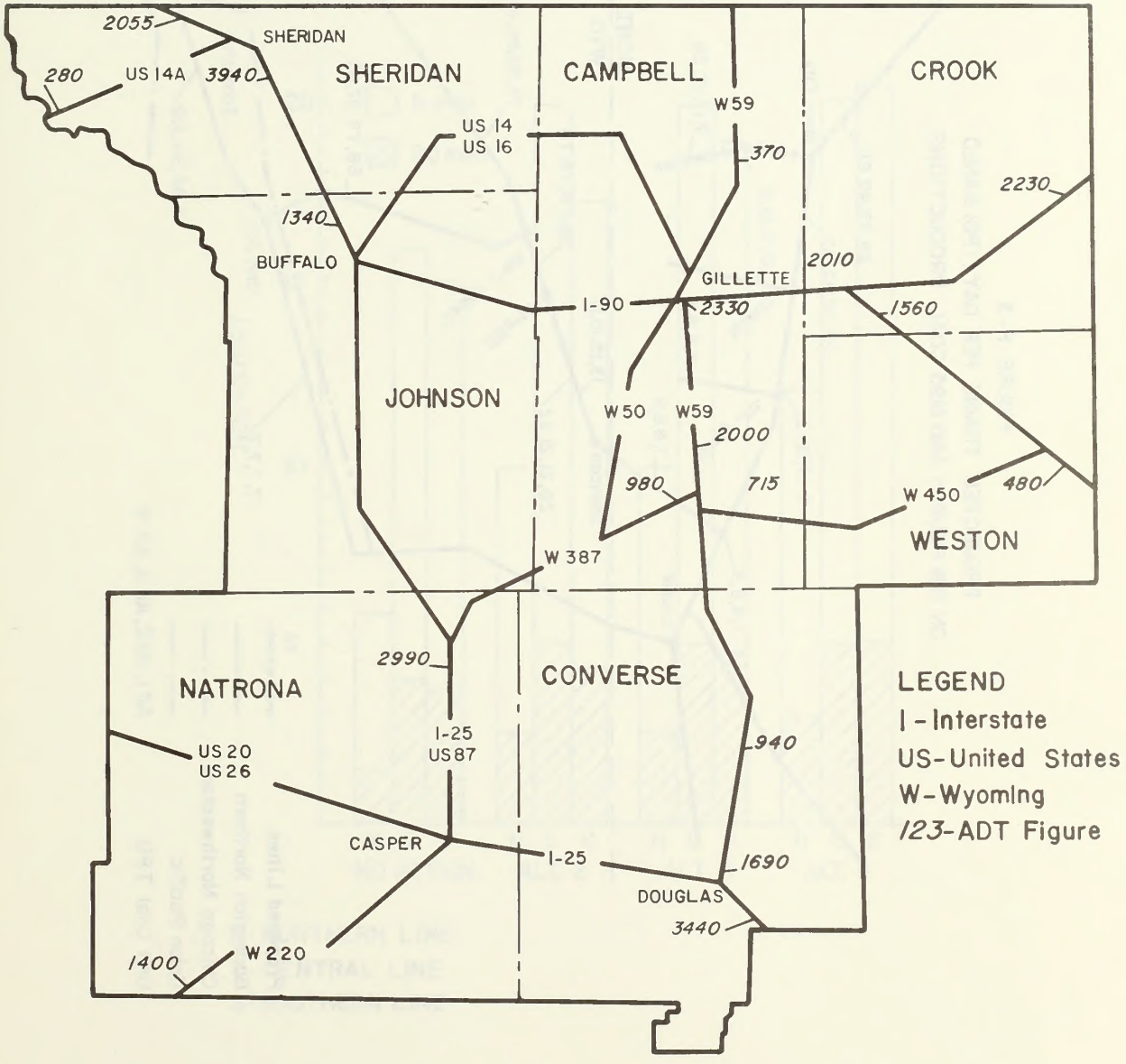


FIGURE F-3
PROJECTED TRAINS PER DAY (TPD) BASED
ON 1981 FIGURES AND 1995 COAL PRODUCTIONS.

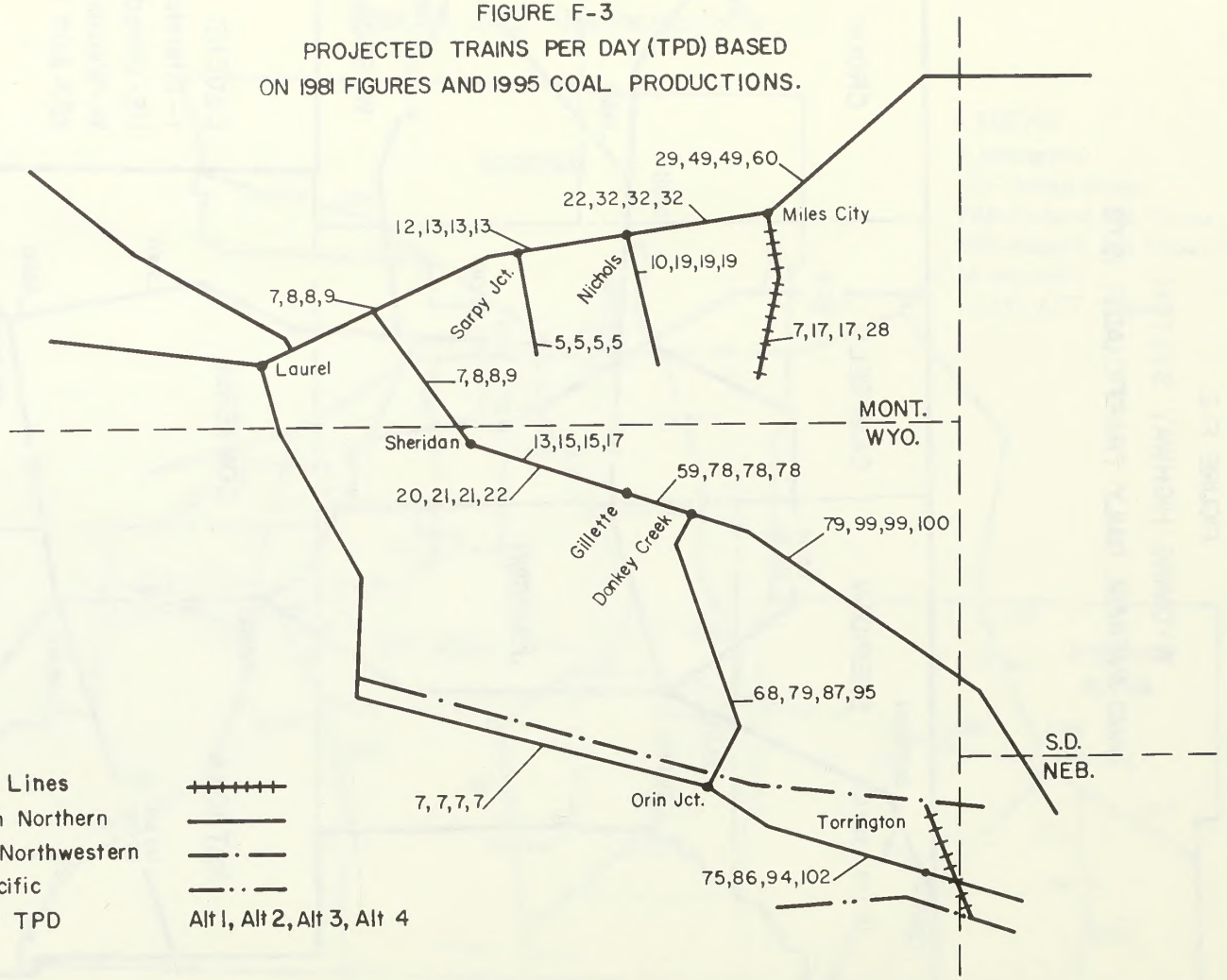
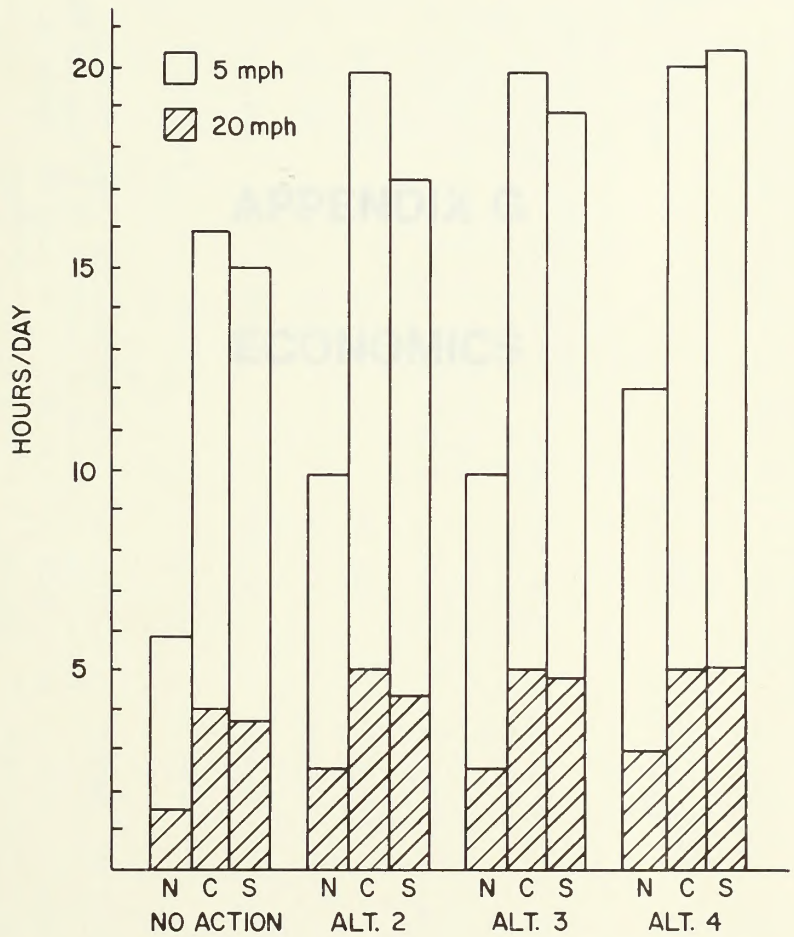


FIGURE F-4
INTERRUPTIONS AT AT-GRADE CROSSINGS
AT PEAK PRODUCTION



N-NORTHERN LINE
C-CENTRAL LINE
S-SOUTHERN LINE

APPENDIX G

ECONOMICS

TABLE G-1
ANNUAL DOLLAR LOSS AND GAIN TO AGRICULTURE IN
MONTANA AS A RESULT OF NEW COAL LEASING

	Annual Loss to Montana through Agricultural Impacts a/				Annual Gains to Montana through Royalty Payments to the Agricultural Landowner		
Alt. b/	Annual Coal Production	Loss in Agricultural Sales	Loss to Gross Regional Prod.	Regional Loss Per Million Tons of Coal	Gain to the Agricultural Landowner c/	Gain to Gross Regional Product d/	Regional Gain Per Million Tons of Coal
	(million tons)	($)	($)	($)	($)	($)	($)
2A/3A	36.3	88,480	228,368	6,291	726,000	363,000	10,000
2B/3B	29.9	56,280	145,260	4,858	598,000	299,000	10,000
2C/3C	32.2	78,596	202,807	6,298	644,000	322,000	10,000
4	55.5	116,032	299,479	5,396	1,110,000	555,000	10,000

a/ Don Waite, Agricultural Economist, BLM Montana State Office, Billings, Montana.
b/ Subalternatives are retained to illustrate significant differences in impacts to agriculture.
c/ Assumes annual royalty payments of 2 cents per ton of coal production, based on a range of 2 cents to 35 cents per ton of coal mined for regional landowner lease agreements.
d/ Assumes a multiplier of .5 times agricultural landowner income.

TABLE G-2
1979 CROP PRODUCTION AND CATTLE INVENTORY IN
POWDER RIVER AND ROSEBUD COUNTIES COMPARED TO
MONTANA AND THE U.S.

	Bushels Per Acre	Total Production Million Bushels
Barley		
Powder River County [a]	22.5	.11
Rosebud County [a]	45.0	.29
Montana [a]	39.0	40.56
U.S. [b]	50.6	378.07
Corn (Grain)		
Powder River County [a]	---	---
Rosebud County [a]	78.0	.08
Montana [a]	77.0	.39
U.S. [b]	109.4	7,763.77
Oats		
Powder River County [a]	31.0	.05
Rosebud County [a]	48.0	.08
Montana [a]	39.0	5.46
U.S. [b]	54.4	534.39
All Wheat		
Powder River County [a]	24.3	0.98
Rosebud County [a]	25.2	1.07
Montana [a]	22.7	116.48
U.S. [b]	34.2	2,141.73
All Hay	Tons Per Acre	Million Tons
Powder River County [a]	1.37	.09
Rosebud County [a]	2.04	.09
Montana [a]	1.80	4.29
U.S. [b]	2.39	145.88
Cattle Inventory	January 1,	1,000 head
Powder River County [a]	77.6	
Rosebud County [a]	86.1	
Montana [a]	2,607.0	
U.S. [b]	110,864.0	

[a] USDA, 1980a.
[b] USDA, 1980b.

Form 1279–3
(June 1984)

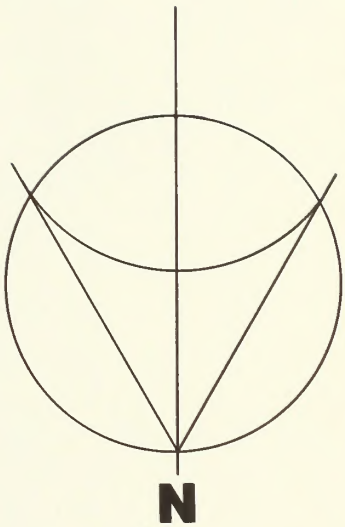
BORROWE

TD 195 .C58 P682 19
Powder River region
environmental impa

DATE LOANED	BORROWER

USDI – BLM

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981 — 777-116/13 Region No. 8


N

N

Billings
Hysham
Forsyth
Miles City
Broadus
Ashland
Birney
Hardin
Sheridan
Sundance

Yellowstone River
Tongue River
Powder River
Bighorn River
Rosebud Creek
Little Bighorn River
Pumpkin Creek
Lame Johnny Creek
Otter Creek
Goose Creek
Tongue River Reservoir
Lake De Smet
Yellowtail Reservoir

Yellowstone County
Treasure County
Custer County
Rosebud County
Big Horn County
Powder River County
Sheridan County

Northern Cheyenne Indian Reservation
Crow Indian Reservation
Ft. MacKenzie Military Reservation
Custer National Forest
Bighorn National Forest
Thunder Basin National Grasslands
Devil's Tower National Monument
Black Hills National Forest

T12N T11N T10N T9N T8NL T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S
R23E R24E R25E R26E R27E R28E R29E R30E R31E R32E R33E R34E R35E R36E R37E R38E R39E R40E R41E R42E R43E R44E R45E R46E R47E R48E R49E R50E R51E R52E R53E R54E
R85W R86W R87W R88W R89W R90W R91W T56N T57N T58N T54N T53N T52N T61N
R82W R81W R80W R79W R78W R77W R76W R75W R74W R73W R72W R71W R70W R69W R68W R67W R66W R65W R64W R63W R62W R61W

Producing Mine
1 Colstrip
2 Big Sky
3 Absaloka
4 Coal Creek
5 Spring Creek
6 Decker East & West
7 Big Horn
8 North Rawhide
9 Eagle Butte
10 Fort Union
11 Clovis Point
12 Wyodak
13 Caballo
14 Belle Ayr
15 Cordero
16 Jacobs Ranch
17 Black Thunder
18 Dave Johnston

Nonproducing Mine
19 Montco Nance
20 CX Ranch
21 Ash Creek
22 Black Mountain
23 Dutchman
24 Wildcat Creek
25 Buckskin
26 Dry Fork
27 South Rawhide
28 East Gillette
29 Peabody
30 Rojo Caballos
31 Coal Creek
32 Wymo Fuels
33 North Rochelle
34 Rochelle
35 Antelope

Delineated Coal Tracts
36 Rock Pile
37 Wildcat
38 Calf Creek
39 Hay Creek
40 Mt. Logan
41 Two Top

Selected Coal Tracts (Maintenance)
42 Colstrip D
43 Colstrip A & B
44 Colstrip C
45 Spring Creek
46 North Decker
47 West Decker
48 Little Rawhide Creek
49 Fortin Draw

Selected Coal Tracts (Competitive)
50 Ashland (Coalwood)
a. Coal Creek
b. Cook Mtn.
51 Ashland (Decker-Birney)
52 Northwest Otter Creek
53 Southwest Otter Creek
54 Spring Draw
55 Rocky Butte
56 Timber Creek
57 Duck Nest Creek
58 Kintz Creek
59 Keeline

Existing Power Plant
60 Colstrip 1
Colstrip 2
61 Neil Simpson
Wyodak
62 Osage
63 Dave Johnston

Proposed Power Plant
64 Colstrip 3
Colstrip 4
65 Wyodak 2

Refinery
66 Osage
67 Wyoming
68 Texaco
69 Little America
70 Glenrock
71 Amoco

Proposed Gasification Plant
72 WyCoalGas

Uranium Mine and Mill Area
73 Irigaray In Situ
74 Greasewood Creek Mine
North Butte Mine & Mill
PINTEC & Thunderbird Joint In Situ
75 Reno Road In Situ
76 Charlie Ore Body Mine & Mill
77 Moore Ranch Mine
Sand Rock Mill
78 Bear Creek Mine & Mill
79 Open Pit & Sectin 34 Mines
80 Teton Exploration In Situ
81 Bill Smith Mine
SPRB Mill
82 Highland Mine & Mill
83 Nine Mile Lake In Situ
84 Morton Ranch Mine & Mill

Bentonite Mine and Mill Area
85 American Colloid Mine & Mill
86 NL-Industries Mine & Mill
87 International Mineral Co. Mine & Mill
88 Federal Bentonite Corp. Colony Mine & Mill
89 American Colloid Mine
90 Federal Bentonite Division Mine
91 Benton Clay Corp. Mine
92 Kaycee Bentonite Corp. Mine
93 Benton Clay Corp. Mill
94 Kaycee Bentonite Corp. Mill

I-90 Exchange
95 Big Horn
96 Gulf
97 Belco
98 Carter-Exxon
99 Kerr-McGee
100 Wyodak

I-90 Exchange and Delineated Coal Tracts

Noncompetitive Leases
101 Peabody Coal Company
102 Consol

Preference Right Lease Applications
103 Ulm Project
104 Wildcat Creek Area
105 Thunderbird Project
Thunderbird II
106 South Gillette
107 Belle Fourche
108 East Black Thunder
109 Rochelle Area
110 North Antelope
111 South Antelope
112 Dull Center
113 Sand Draw
114 Stevens North
115 Stevens South
116 South Powder River

Oil & Gas Field Area

Proposed Coal Slurry Preparation Plant

Existing Transmission Line

Proposed Transmission Line

Existing Railroad

Proposed Railroad

Proposed WyCoalGas Pipeline

Proposed ETSI Pipeline

Sheridan
Sheridan County
Bighorn National Forest
Buffalo
Thunder Basin National Grasslands
Devil's Tower National Monument
Black Hills National Forest
Sundance
Crook County
Black Hills National Forest
Newcastle
Reno Junction
Wright
Johnson County
Campbell County
Weston County
Thunder Basin National Grasslands
Casper
Douglas
Natrona County
Medicine Bow National Forest
Converse County
Medicine Bow National Forest

Due to the small scale, this map is only graphic. More detailed information may be obtained from the tract Profile Reports.

Scale 1:500,000
1 inch equals approximately 8 miles
10 0 10 20 30 40 Miles

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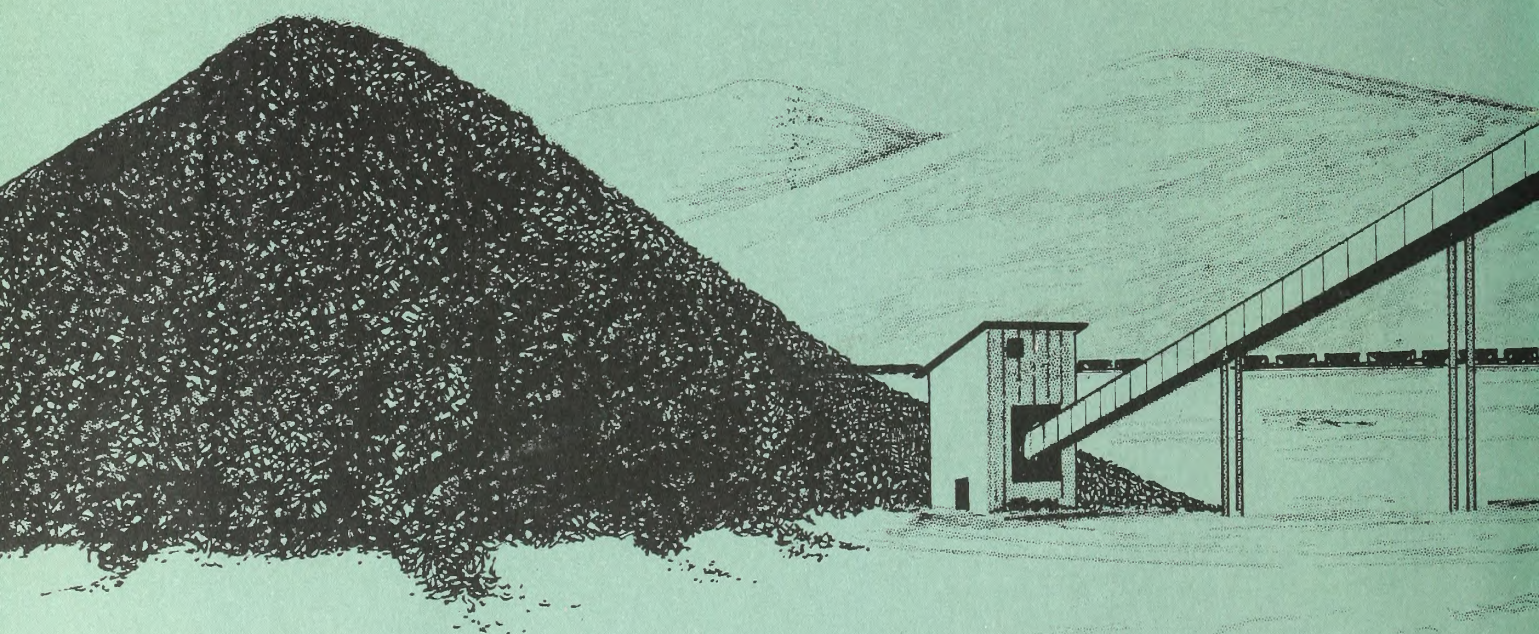
REGIONAL ACTIVITY
Powder River Regional Coal Environmental Impact Statement

* GPO 1981-779-526